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# Current Science



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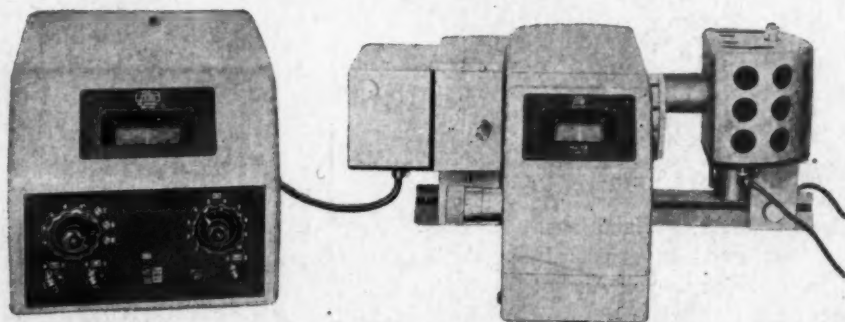
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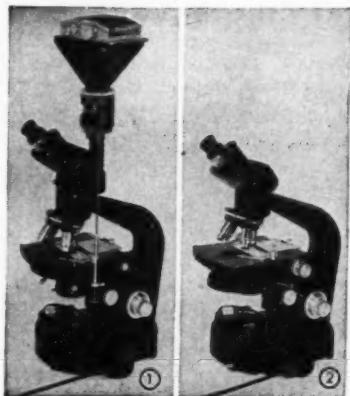
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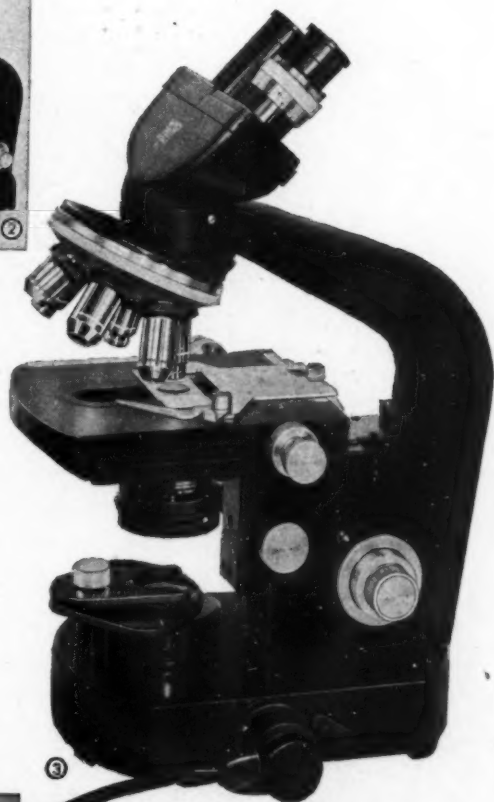
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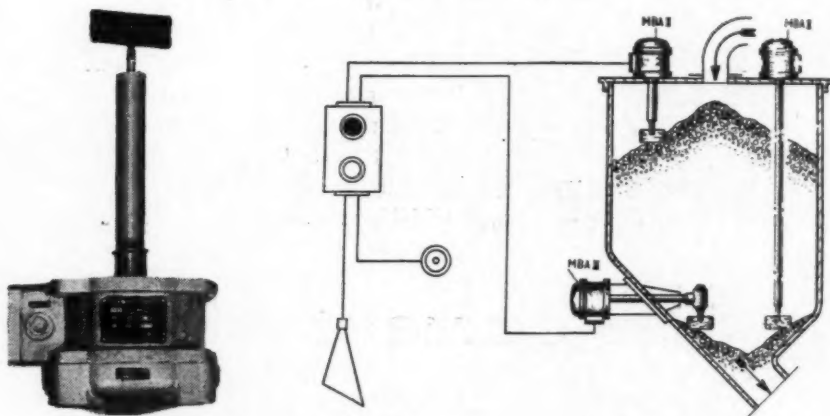
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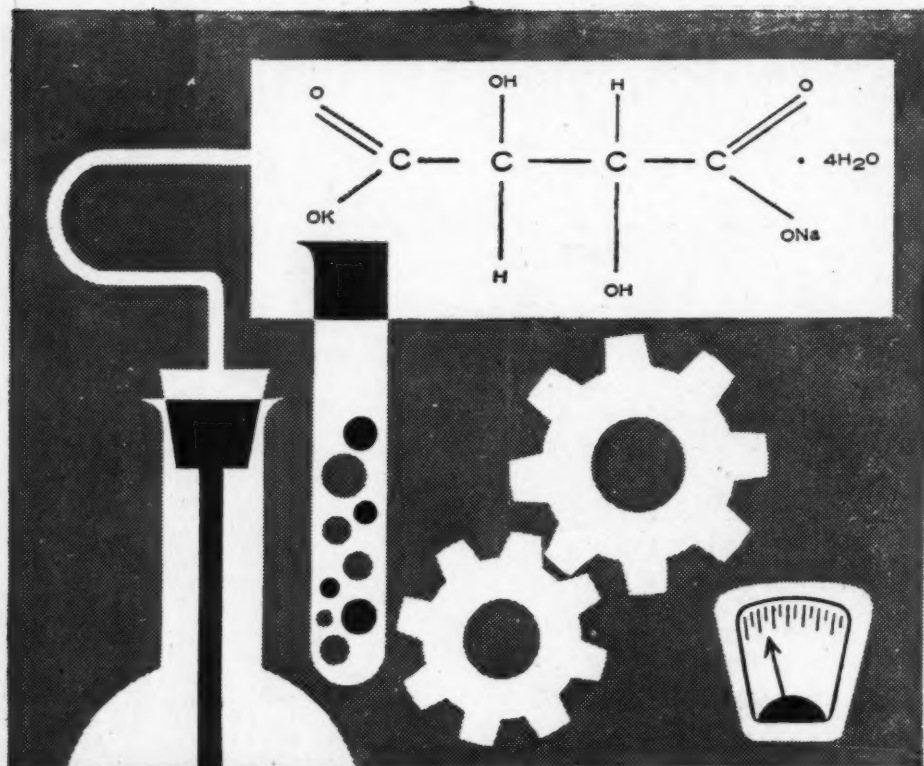
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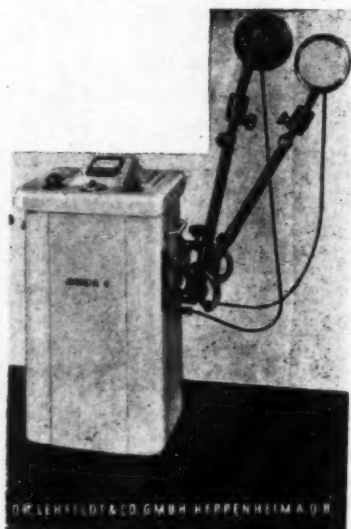
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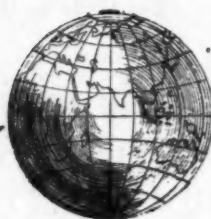
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## HIGH ENERGY PHYSICS

THE Tenth International Conference on High Energy Physics was held at Rochester from August 25 to September 1, 1960. It will be interesting to recall that the High Energy Conference, more commonly known as the 'Rochester Conference', had its origin ten years ago in 1950, as an informal seminar when Prof. Robert E. Marshak invited to Rochester a small group of specialists to discuss the newly discovered pi-mesons and their implications in nuclear problems. With the subsequent discoveries of newer fundamental particles in cosmic radiation, and with the development of great accelerators for the production and study of these particles in the laboratories the scope of this annual conference widened, and the venue of its meetings spread out. The purpose of the annual Conference whose scope now encompasses the whole field of particle physics, is to bring together representative groups of workers from high energy laboratories throughout the world, so that they may present the results of their work done during the year both on the experimental and theoretical side and have informal and comprehensive discussions on them.

The first seven High Energy Conferences were held at the University of Rochester under local auspices. In September 1957, the General Assembly of the International Union of Pure and Applied Physics created a Commission on High Energy Physics to organize the international Conference. This Commission decided to rotate the 8th, 9th and 10th Conferences among Western Europe (CERN, 1958), U.S.S.R. (Kiev, 1959) and U.S.A. (Rochester, 1960).

The 10th Conference was attended by about 350 nuclear physicists, representing laboratories from 30 countries. In all there were some 170 contributions besides 30 invited papers. To cope with this large amount of work and also to see that the participants got the maximum benefit out of the Conference, the organising Committee divided the contributions into four groups, namely, (1) Strong interactions of pions and nucleons (experimental); (2) Strong interactions of pions and nucleons (theoretical); (3) Strong interactions of strange particles, and (4) Weak interactions. The papers under each group were presented and discussed at smaller 'working' sessions, on the first two days in four simultaneous half-day sessions. There were four half-day plenary sessions on the last four days at which *rapporteurs* summarized the highlights of the material presented at the

simultaneous sessions. Also there were three half-days of plenary sessions for invited papers in three fields of general interest, namely, Structure of elementary particles; New results at superhigh energies; and Theories of elementary particles. Ample time was provided for discussions which formed the more important feature of the Conference.

On the experimental side on the strong interactions of pions and nucleons, two experiments to measure the lifetime of the neutral pion were reported. The first of these by Tollestrup and his collaborators of the California Institute of Technology, was based on observation of the photoproduction process in the Coulomb field using 900 MeV photon. This gave for the  $\pi^0$  lifetime a lower limit value of  $5 \times 10^{-17}$  sec. The second experiment, by Glasser *et al.* of the Naval Research Laboratory, was based on a direct measurement of the  $\pi^0$  decay distance which gave the mean lifetime as  $(2.3 \pm 0.8) \times 10^{-16}$  sec.

Valladas gave a summary of the most recent measurements of total cross-section of pion proton scattering made with the proton synchrotron at Saclay, in the energy region 400 MeV to 1.5 GeV. The Saclay results for energy and cross-section at maxima are:  $605 \pm 5$  MeV,  $\sigma = 45.8 \pm 1.8$  mb.;  $890 \pm 9$  MeV,  $\sigma = 58.0 \pm 1.8$  mb. There are small differences between the results of Saclay and Berkeley which have not yet been understood. The chief object of all these experiments, of course, is to help in assigning definite angular momenta and parities to the states which are especially important near the sharp maxima in the total cross-section. The Saclay data are consistent with the assignments of  $d_{3/2}$  and  $f_{5/2}$  to the states associated with the maxima at 600 MeV and 900 MeV respectively.

During the past year considerable interest, both theoretical and experimental, has centred on the question of the strength of interaction between a pair of pions. The main problem is the application of dispersion theory to pion physics is to obtain explicit forms of the scattering amplitudes which satisfy unitarity and have the correct location of the singularities in the kinematical invariant variables.

At the Conference three different programmes were presented. Chew gave a description of his own work with Mandelstam on the pion-pion interaction carried during the year at Berkeley. This work was along the lines reported in Kiev, concentrating attention on the

type of solution in which the P-phase shift may be large at low energies.

The programme of the European group at CERN was presented by Cini and Fubini. In both these methods the equations obtained at the end are essentially the same although the procedures are different, and the approximations which are necessarily to be introduced are done at different stages. Details of studying the problem by an entirely different method were presented by Shirkov (Dubna). The two approximations that are usually made in the derivation of integral equations from dispersion relations and the unitary condition are, firstly, the two-particle intermediate approximation, and secondly, consideration of low angular momentum waves only,—the contribution from the higher angular momentum states being usually neglected. While these approximations can be justified in low energy phenomena, one has to be careful in neglecting the higher waves in what may be called the 'unphysical' region where it may lead to large errors. The Dubna programme outlines a new method of approach in which only those angles are chosen for deriving integral equations, for which the Legendre expansion fails only at the distant part of the unphysical region. The data calculated on this method seem to give evidence of *s*-wave scattering, although about *p*-wave scattering they are inconclusive.

Three papers presented on the experimental side of pion-pion scattering also evoked considerable interest and discussion. Since one cannot make a target of free pions, one possible experimental approach is to look for particular correlations between a pair of pions produced in the final state of some reaction. Crowe and his collaborators (Berkeley) studied the reactions  $p + d \rightarrow \text{He}^3 + \pi^0$  ( $\rightarrow \text{He}^3 + \pi^+ + \pi^-$ ), using incident proton energies ranging from 624 to 743 MeV. The  $\text{He}^3$  momentum spectra show besides high momentum peaks due to  $\pi^0$  production, a continuum at lower momentum which may be attributed to double pion interaction. Derado who studied the process  $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ , at 1 BeV using a hydrogen bubble chamber found a low energy peak in the kinetic energy spectrum of the proton which he has interpreted in terms of a pion-pion correlation. A similar interaction was studied by Anderson *et al.* (Berkeley) following the suggestion of Chew and Low. They reported the results of their study of photographs taken with the 72-inch hydrogen bubble chamber which was exposed to a Bevatron  $\pi^-$ -beam of 1.03 BeV/c.

From the contributions made at the Conference on the experimental results of the strong interaction of strange particles one may conclude that the past year has been reasonably productive from the point of view of data accumulation but quite unproductive from the point of view of real understanding. For the first time results at very high energies, above 3 BeV were presented both from the Russian accelerator and the CERN accelerator. In addition there have been some new results in proton-proton production and photo production of strange particles.

The Dubna studies on the production of strange particles by 7-8 BeV pions in a propane chamber have yielded the following measurements of total cross-sections:  $\sigma(Y^0 + K^-)$

$$= 0.8 \pm 0.25 \text{ mb}; \quad \sigma(K^0 + \bar{K}^0) + \sigma(K^0 + K^-) + \sigma(\bar{K}^0 + K^+) = 12 \pm 0.3 \text{ mb}.$$

Good (Wisconsin) reported the results of his study of the reaction  $K^- + p \rightarrow \Lambda + \pi^- + \pi^+$ . The structure of the momentum spectra of the pions suggests the existence of quasi-stationary states of the  $\pi - \Lambda$  system.

Panofsky gave a review of the work in progress on the collision of very high energy electron beams produced in the Stanford linear accelerator. The energy involved will be several thousand BeV, and it is expected that the results will be one of great significance as they will enable one to examine the validity of quantum electrodynamics in an energy region which has so far only been accessible in rare cosmic ray events.

Regarding the investigations on weak interactions, the question of the universality of weak interactions came in for much discussion. Feynman has investigated the problem with special reference to the lifetime of the muon. From the beta-decay data of  $\text{O}^{14}$  he calculates the muon lifetime as  $2.251 \pm 0.012 \mu \text{ sec}$ . Gell-Mann outlined a more abstract formulation of the universality idea, which might be able to cope with the weak interactions of all particles.

In the plenary session on New results at superhigh energies, Cocconi reported on the main results obtained with the 25 GeV proton synchrotron of CERN since it went into operation on November 24, 1959. One of the unexpected results was the production of light nuclei deuterons, tritons, and  $\text{He}^3$  in the collision of the GeV protons with the target material. Veksler reported the Dubna results on the behaviour of nuclear particles colliding at high energies with special reference to

collision of pions with nucleons, nucleons with nucleons, and the production of strange particles by pions on protons. One important result that has been established at Dubna is that there is an increase in the production of K-meson pairs with an increase of energy of the primary particle.

Four invited papers were presented at the plenary session on Theories of elementary particles. This session naturally evoked considerable discussion. There always remains the question whether all the elementary particles of today are really 'elementary' or 'basic'. They are recognised as elementary on the basis of our present knowledge of nature. They may not stand as the most basic elements of matter at the next stage of physics. In fact, Fermi and Yang pointed out, as long ago as 1948, a possibility of explaining the  $\pi$ -meson as a compound state of a nucleon and an anti-nucleon. One of the current problems of particle physics on the mathematical side is to evolve a unified theory of fundamental particles. Ohnuki (Japan) spoke on the extension of Sakata's composite model of elementary particles. One interesting outcome of Ohnuki's investigation is the existence of a neutral meson with zero isotopic spin. This has been called  $\pi^0$ . It comes out as one of the configurations of the composite model of one baryon and one antibaryon system. Any experimental evidence for this pseudoscalar meson has not so far been found.

Blockhintsev presented some new results obtained by his group at Dubna by the New functional methods in the field theory. Heisen-

berg reported on the progress of research on the non-linear spinor theory carried out during the year by his theoretical group at Munich. The chief assumption in this attack of the problem is that the symmetry principles rather than the particles themselves are regarded as the elementary notions of physics.

The above summary, though cursory, is sufficient to indicate the voluminous work that is being done on many fronts on the physics of high energies. There is no doubt that the delegates to the Conference obtained quite a lot of new information both on the experimental and the theoretical sides of the various problems connected with high energy physics. As a result of the discussions while many doubts were cleared, some were also deepened. After all, "one criticizes, one learns, gets information, and thereby the progress of science is maintained".

The full Proceedings of the Tenth Conference have been published as an impressive volume of 900 pages.\* It will be clear that with this growing activity in this field of particle physics one year interval will be too short a period to understand the full implications of the results obtained and to draw definite conclusions therefrom for presentation. In this context the decision of the IUPAP to hold the Conference on a biennial basis will be welcomed.

The Eleventh Conference will be held at CERN in July 1962.

\* *Proceedings of the Tenth Annual International Conference on the High Energy Physics, Rochester, 1960.* (Interscience Publishers, New York-L), 1960. Pp. xxv + 890. Price \$ 13.50.

## THE EARTH'S CRUST

**A** SPECIAL place in international geophysical research programmes is occupied by explorations of close-lying strata of the earth's mantle, the layer underlying the solid crust. The sialic zone of the earth includes the lightest rock composed of granites, gneissic and sedimentary rock. Its specific gravity is 2.8, as compared with the earth's mean specific gravity of 5.5. In continental region, the earth's crust is 25 to 40, rarely up to 60, kilometres thick. Under the ocean bottom the sialic zone is only a few kilometres thick.

The temperature in the lower layers of the earth is not uniform. In the Ukrainian crystalline shield province, for example, the temperature rises by 8.3° per every kilometre downwards and reaches some 250° C. beneath

the crust. In the volcanic Carpathian mountains the temperature rises by 35° per kilometre and beneath the crust is as high as 1,200° C.

The age of the earth and the solar system is 5,000 to 6,000 million years. The latest researches indicate that the matter of our planet has existed as a solid for at least 4,000 to 5,000 million years. The age of the oldest discovered rock is set at 3,500 million years.

The history of the earth's crust counts 16 cycles of mountain formation, folding and mineral formation, each lasting from 200 to 300 million years. The latest is the Alpine mountain-forming cycle, in which the Carpathians and the Crimean mountains appeared. This cycle began some 220 million years ago. —(USSR News.)

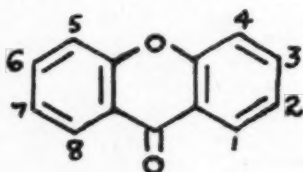
OCCURRENCE OF C<sub>6</sub> UNITS IN XANTHONES

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## NATURALLY OCCURRING XANTHONES

FOR a long time only two xanthones of definite constitution, viz., gentisin (I) and euxanthone (II) were known to occur in Nature. Recently more xanthones have been found as components of important vegetable drugs and also as mould and lichen products. Some of them are reported to be physiologically active. They may have uses also as analytical reagents. The following (Table I) is a list of xanthones so far obtained from natural products. In the compounds whose structures have been more or less definitely established, an *ortho*-hydroxy carbonyl system is invariably present.



## BIOGENESIS OF XANTHONES

Structurally xanthones are closely related to benzophenones and laboratory synthesis of the former is based on this relation (Chart 1).

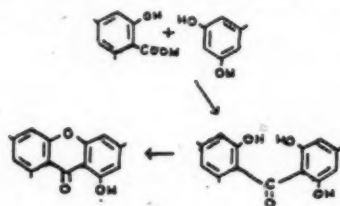


CHART 1

But with regard to their biogenesis, naturally occurring xanthones and benzophenones seem to have different lines of evolution. This is indicated by the substitution patterns of the two benzene rings present in them. The benzophenones have been considered to be derived

TABLE I

Compound	Structure	Source
1 Lichexanthone (III)	.. 1-Hydroxy-3 : 6-dimethoxy-8-methylxanthone	<i>Parmelia formosana</i> <sup>1</sup> , <i>P. quercina</i> <sup>2</sup>
2 Demethyl-lichexanthone (IV)	.. I : 6-Dihydroxy-3-methoxy-8-methylxanthone	<i>Penicillium patulum</i> <sup>3</sup>
3 Ravenelin (V)	.. 1 : 5 : 8-Trihydroxy-6-methylxanthone	<i>Helminthosporium ravenelii</i> , <i>H. turticum</i> <sup>4</sup>
4 Gentisin (I)	.. 1 : 7-Dihydroxy-3-methoxyxanthone	<i>Gentiana lutea</i> <sup>5</sup>
5 Euxanthone (II)	.. 1 : 7-Dihydroxyxanthone	Urine of cows fed on <i>Mangifera indica</i> leaves <sup>6</sup> , <i>Platonia insignis</i> <sup>7</sup>
6* Norswertianol (norswerchirin) (VI)	1 : 3 : 5 : 8-Tetrahydroxyxanthone	<i>Swertia japonica</i> <sup>8</sup> , <i>S. chirata</i> <sup>9</sup>
7* Nordecussatin (norswertinin) (VII)	1 : 3 : 7 : 8-Tetrahydroxyxanthone	<i>Swertia decussata</i> <sup>10</sup>
8 Sterigmatocystin (VIII)	.. 8-Hydroxy-1-methoxyxanthone with extra dihydro-difuran (3 : 4 : 1' : 2') system	<i>Aspergillus versicolor</i> <sup>11</sup>
9 Mangiferin (IX)	.. 2-C-Glucosyl-1 : 3 : 6 : 7-tetrahydroxyxanthone	<i>Mangifera indica</i> <sup>12</sup> , <i>Salacia prinosides</i> <sup>13</sup>
10 Mangostin (X)	.. 2 : 8-Di (γγ-dimethyl) allyl-1 : 3 : 6-trihydroxy-7-methoxyxanthone	<i>Garcinia mangostana</i> <sup>14</sup>
11 Jacareubin (XI)	.. 1 : 5 : 6-Trihydroxy-(2' : 2'-dimethyl 5' : 6' : 2 : 3-pyranu.) xanthone	<i>Callophyllum brasiliense</i> <sup>15</sup>
12* Nor-rubrofusarin (norasperxanthone)	1 : 7 : 8-Trihydroxy-2-methylxanthone(?)	<i>Fusarium culmorum</i> <sup>16</sup> , <i>Aspergillus niger</i> <sup>17</sup>
13 Corymbiferin	.. Undetermined	<i>Gentiana corymbifera</i> <sup>18</sup>
14 Morellin	.. do.	<i>Garcinia morella</i> <sup>19</sup>

\* These xanthones occur in Nature as their partial methyl ethers. For example, swertianol is a monomethyl ether; decussatin, a trimethyl ether; swertinin, a dimethyl ether; swerchirin, a dimethyl ether; rubrofusarin, a monomethyl ether; asperxanthone, a dimethyl ether. In the above compounds, the position of the methoxyl group has not been fully established.



from 4-phenylchromans or the corresponding coumarins<sup>20</sup> which are formed from a phloroglucinol ( $C_6$ ) unit (A) and a cinnamic acid ( $C_3$ ) unit (B) by the process indicated below (Chart 2). These coumarins (XII) or better the corresponding coumaric acids (XIII) seem to act as precursors and yield the benzophenones (XIV) by oxidation.

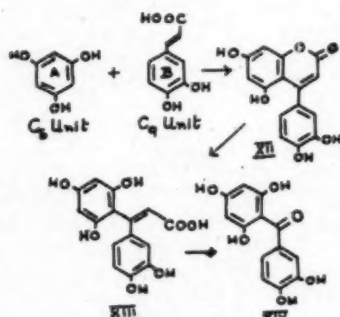


CHART 2

#### BIOGENESIS OF LICHEXANTHONE (III) AND RAVENELIN (V)

Of the various naturally occurring xanthenes, lichexanthone (III) is a lichen product and is the simplest based on the  $C_8$  unit origin. The presence of  $C_8$  unit is obvious. Its biogenesis has already been discussed in an earlier paper.<sup>21</sup> The formation of norlichexanthone (XV) involves a  $C_8$  (orsellinic) unit (A) and a  $C_6$  (phloroglucinol) unit (B) (Chart 3). Partial methylation of the more reactive 3- and 6-hydroxyl groups leads to lichexanthone (III). The formation of demethyl-lichexanthone (IV), a mould metabolic product, from norlichexanthone (XV) seems to involve monomethylation in the 3-position. This selective methylation of the 3-hydroxyl group may be significant. Of the two reactive hydroxyl groups, viz., 3 and 6, which are not symmetrically located, the former seems to be more acidic because of the presence of the 1-hydroxyl group in the same ring. The exact reason for this is not at present clear.

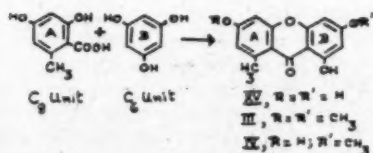


CHART 3

Though ravenelin (V), a fungal product, is isomeric with norlichexanthone (XV) and is derived from similar units, it exhibits marked difference in regard to the location of the methyl and hydroxyl groups and should, therefore, have a more complex biogenesis. As indicated in earlier papers,<sup>21,22</sup> the phloroglucinol part (B) has undergone nuclear reduction (loss of phenolic hydroxyl group) to a resorcinol (XVI) unit. Regarding the other part (A), 3-carboxyorsellinic acid (XVII) may be the modified orsellinic unit involved and it undergoes partial decarboxylation to para-orsellinic acid (XVIII). These two units (XVI and XVIII) could give rise to the intermediate xanthone (XIX). Para-nuclear oxidation in ring (A) of this xanthone would lead to ravenelin (V) (Chart 4). Based on these considerations, a convenient synthesis of ravenelin has recently been achieved.<sup>22</sup>

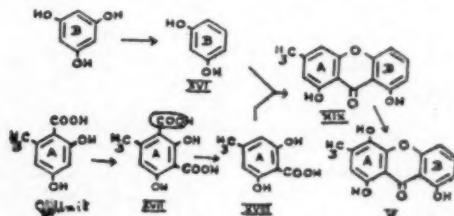


CHART 4

#### BIOGENESIS OF GENTISIN (I) AND EUXANTHONE (II)

The xanthenes of higher plants seem to have the same evolution though their structures appear rather different. In all of them, there is a phloroglucinol ( $C_6$ ) unit or the derived resorcinol unit. But instead of a simple orsellinic ( $C_8$ ) unit, a modified one seems to be found. In the simpler members, gentisin (I) and euxanthone (II), a gentisic acid (XX) unit is present. In an earlier paper,<sup>21</sup> the origin of gentisic acid (XX), which is a metabolic product of *Penicillium* spp., was traced to  $C_8$  unit (Chart 5).

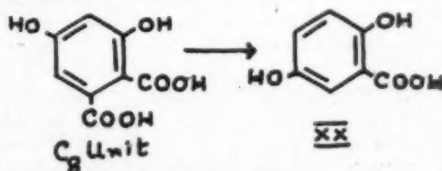


CHART 5

Gentisein (norgentisin) (XXI) may represent an earlier stage in evolution and would be the product of combination of phloroglucinol and gentisic acid (XX) (Chart 6). The formation



of gentisin (I) involves partial monomethylation of the more reactive 3-hydroxyl group.<sup>23</sup> Euxanthone (II) may arise from gentisein (XXI) by nuclear reduction. The laboratory conversion of gentisein (XXI) to euxanthone (II) follows this possible biogenetic pathway.<sup>24</sup> In this process, gentisein is monotosylated in the 3-position and the resulting tosyl ester (XXII) reduced with hydrogen and Raney nickel (hydrogenolysis).

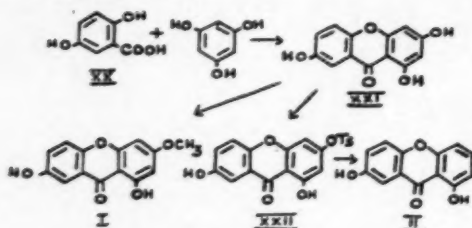


CHART 6

#### BIOGENESIS OF *Swertia* XANTHONES (VI AND VII)

The *Swertia* xanthenes are based on 1:3:5:8-tetrahydroxy-(VI) and 1:3:7:8-tetrahydroxyxanthenes (VII). In these, one of the units (B) is phloroglucinol as in the earlier cases but the other is a 6-hydroxygentisic acid unit (XXIII). The fact that these isomeric xanthenes are found in the same genera may suggest very similar origin. The following derivation of 6-hydroxygentisic acid (XXIII) from  $C_8$  unit may be suggested (Chart 7). In this, 6-formyl-2:4-dihydroxybenzoic acid ( $C_8$  unit) undergoes nuclear reduction of the 4-hydroxyl group (XXIV); subsequent *para*-nuclear oxidation would lead to 6-formyl-2:5-dihydroxybenzoic acid (XXV). Oxidation (Dakin's type) of this hydroxy aldehyde derivative would give 6-hydroxy-gentisic acid (XXIII). Similar oxidations have been shown to be important stages in the evolution of flavonoids and lichen acids and the feasibility of these under laboratory conditions has also been demonstrated.<sup>25</sup>

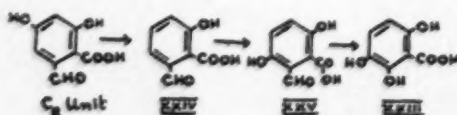


CHART 7

The isomeric tetrahydroxyxanthenes (VI and VII) may arise by ring closure in two alternative directions, the former involving the 6-

hydroxyl group and the latter, the 2-hydroxyl group, respectively, of the hydroxygentisic acid (XXIII) (Chart 8).

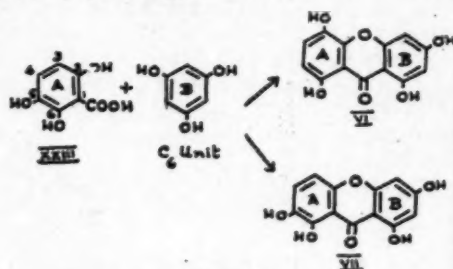


CHART 8

#### BIOGENESIS OF STERIGMATOCYSTIN (VIII)

Sterigmatocystin (VIII) is a derivative of 1:3:8-trihydroxyxanthone and thus has a phloroglucinol unit (B) as in a number of cases mentioned above. The other part is derived from 1:6-dihydroxybenzoic acid ( $\gamma$ -resorcylic acid). Further, there is a di-(dihydro)-furan system involving a  $C_4$  unit probably derived from a sugar. The 1:3:8-trihydroxyxanthone may arise from 1:3:5:8-tetrahydroxyxanthone (VI) by a process of nuclear reduction (Chart 9). Such loss of *para*-hydroxyl group in quinol systems is known, e.g., 1:2:3:5-tetrahydroxybenzene to phloroglucinol.<sup>26</sup>

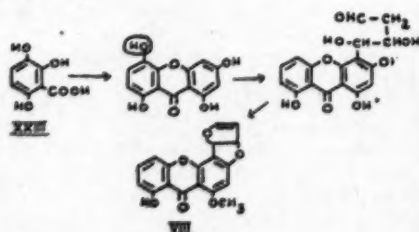


CHART 9

#### BIOGENESIS OF COMPLEX XANTHONES [MANGIFERIN (IX) MANGOSTIN (X) AND JACAREUBIN (XI)]

Under more complex types come mangiferin (IX), mangostin (X) and jacareubin (XI). The first two are derivatives of 1:3:6:7-tetrahydroxyxanthone (XXVI) and the third has a 1:3:5:6-hydroxy system (XXVII). In these two tetrahydroxyxanthenes (XXVI and XXVII) ring (B) is again phloroglucinol and the other ring (A) may again be traced to  $C_8$  units. The tentative suggestions are embodied in the formulae of Chart 10. In the case of 1:3:6:7-tetrahydroxyxanthone system (XXVI), ring (A)

may arise from 3:5-dihydroxyphthalic acid (DHP) (XXVIII) undergoing *para*-nuclear oxidation to 3:5:6-trihydroxyphthalic acid (XXIX). For the formation of 1:3:5:6-tetrahydroxyxanthone (XXVII), the corresponding ring may result from *ortho*-nuclear oxidation of DHP (XXVIII) to 3:4:5-trihydroxyphthalic acid (XXX). Similar reactions involving *para*- and *ortho*-nuclear oxidations are frequently met with in lichen acids.<sup>25,27</sup> Further, there is loss of a single carbon atom (decarboxylation) in the 8-position of both the xanthenes to yield the final products.

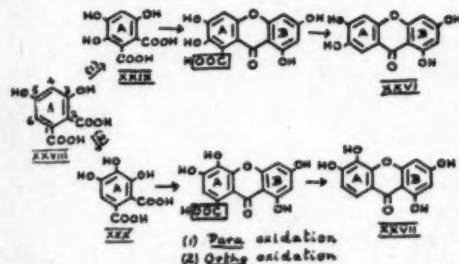


CHART 10

Mangiferin (IX) is a glucosyl derivative in which the sugar unit is linked to a carbon atom (position 2) instead of to oxygen (Chart 11). A number of examples of this type of C-glycosyl derivatives have recently been discovered.<sup>28</sup> Mangostin (X) and jacareubin (XI) are more complex and contain isoprene ( $C_5$ ) units which appear to have entered the xanthone structure at a later stage.

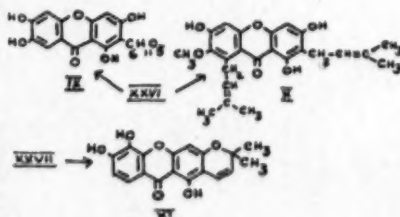


CHART 11

## XANTHONES OF INDEFINITE STRUCTURE

The structure of nor-rubrofusarin was tentatively given as 1:7:8-trihydroxy-2-methylxanthone or its corresponding 1:6:7-hydroxyisomer.<sup>29</sup> This does not fit into the above scheme of biogenesis because the methyl group is in an unusual position, viz., 2-position. However, the validity of these structures has been questioned by Robertson and co-workers<sup>17</sup> who

also found that nor-rubrofusarin was identical with non-asperxanthone. Similarly the full structures of corymbiferin and morellin have also not been established so far.

## MODE OF XANTHONE FORMATION

At this stage should be discussed the mode of linking between the two units. The familiar synthetic method in which an *ortho*-hydroxy carboxylic acid is condensed with phloroglucinol or resorcinol (Chart 1) in the presence of a condensing agent may be an obvious suggestion, e.g., the synthesis of lichexanthone<sup>30</sup> and gentisein.<sup>31</sup> Another possible method seems to be the condensation of an *ortho*-hydroxy aldehyde (XXXI) with a phloroglucinol unit leading to a fluorone derivative (XXXII). From this to the xanthone requires an oxidation stage. For the evolution of lichexanthone (III), orcylaldehyde and for the evolution of gentisein (XXI), gentisic aldehyde would be involved. But in the laboratory adoption of this course, reduction of the fluorone (XXXII) to the corresponding xanthene (XXXIII) and subsequent oxidation yield the xanthone (XV) (Chart 12). This procedure has been used for the synthesis of lichexanthone<sup>1,2</sup> (III).

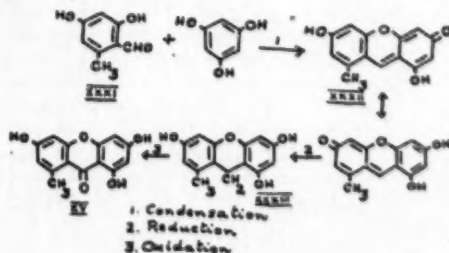


CHART 12

## SUMMARY

A large number of xanthone derivatives have recently been isolated and characterized. All of them seem to be biogenetically capable of coming into a mixed type consisting of a  $C_0$  and a  $C_5$  unit. The simplest is represented by lichexanthone and others involve more stages of transformation. They are conveniently classified on this basis. The formation of xanthone skeleton itself could be visualized in two alternative ways involving condensation of either a carboxylic acid or an aldehyde.

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### SOLAR ENERGY

THERE are two chief methods of harnessing solar energy. The first is the direct method or the "greenhouse" method known to all horticulturists. The interior of the greenhouse heated by the sun's rays, reflects long infra-red waves to which the glass is opaque. The heat of these rays is caught as it were in a trap: it cannot escape and tends to accumulate in the glassed-in space. This method, therefore, allows the sun's rays to enter through a glass surface and prevents the radiation of bodies heated by the sun from escaping. The direct method can produce temperatures up to 150° C.—however, the practical working temperatures are kept at a lower level between 60° and 80° C.

The second method is by concentration of the solar rays on suitable collectors whereby temperatures ranging from several hundred to a few thousand degrees can be obtained. Two types of collectors are generally used: (i) The 'flat' collector consisting basically of a dark plate, insulated on the side away from the sun, and protected from the wind on the side facing the sun by a transparent pane. The plate may heat either liquid-filled pipes attached to it or air. (ii) The 'focusing collector' uses mirrors in order to concentrate the sun's rays upon a small receiving object with a dark surface. In general, the focusing collectors must be continually manoeuvred to follow the sun's movement.

The design and efficiency of the collectors have been improved in recent years by the use of new materials and of darkened selective surfaces with low radiating power, thus leading to higher operative temperatures. Glass, anodised aluminium and new plastics aluminised in a vacuum have been used for focusing collectors.

A third type of collector, suitable for very large surfaces, has been studied in France and in Israel. This is the 'solar pool', a shallow basin with a darkened bottom whose operation is based upon the principle of water density. By dissolving salts in the water at the bottom of the pool, a very salty layer is obtained while the top layer remains unsalted, the difference in density preventing them from mixing. The top layer keeps an even temperature, because it loses its heat at the same rate as it stores it, but the heat generated in the salty water at the bottom of the pool does not escape and it can be used as a source of power.

Conversion of solar heat into electricity through thermocouples has reached a high degree of development, thanks to improvements resulting from basic research in solid state physics. Progress in this field of solar converters has been particularly noteworthy in US and USSR under their programme of space research.—(UNESCO).

## WIND AS A SOURCE OF ENERGY IN INDIA

AS the pressure of population increases and natural resources get depleted all progressive nations have to look to new sources of energy. The United Nations as well as individual nations have been lately devoting considerable time and energy to the harnessing of new sources of energy like Wind Power, Solar Energy, Tidal Energy and so on. In India too, these new sources of energy have been receiving attention in the last few years. In this context we have recently received a Review of Progress on Utilization of Wind Power issued by the National Aeronautical Laboratory, Bangalore, on the occasion of a recent meeting of the Wind Power Sub-Committee of the Council of Scientific and Industrial Research.

The project on the utilization of Wind Power in India was initiated by Prof. M. S. Thacker, and Dr. P. Nilakantan was the Investigator-in-Charge since 1952. Mr. E. W. Golding of the British Electrical and Allied Industries Association, U.K., who is an authority on the utilization of Wind Power came to India in September 1954, to attend the Symposium on Solar Energy and Wind Power held in New Delhi under the auspices of the UNESCO and CSIR. He visited various places in India and felt convinced about the great scope for Wind Power development in India, though on different scales and for different purposes in various districts. To accomplish a significant amount of development, he recommended that there should be a staff of investigators devoting full time to experimental studies of several aspects of the subject, that facilities should be afforded for both theoretical and experimental work, and that a Workshop and a Laboratory should be established. Extensive Wind Velocity Surveys in selected areas in different parts of the country have to be made. He also recommended that research should be directed in the first instance to the development of small- and medium-sized wind electric generators. These were accepted by the Board of Scientific and Industrial Research and endorsed by the Governing Body in 1957. It is gratifying to note that with a view to implement the recommendations, a Wind Power Division has been formed as a part of the National Aeronautical Laboratory which was started in Bangalore in 1960. All the necessary facilities for the development of Wind Power as recommended by Mr. E. W. Golding will be available in this Laboratory. During the few years prior to the starting of the National Aeronautical Laboratory, the small

nucleus of the Wind Power Division of the CSIR have already developed two prototype windmills suited to Indian conditions and have been fabricated using indigenous materials which on test have worked very satisfactorily. The fabrication of some of them for experiments in different parts of India under different conditions is programmed for the immediate future. Necessary experience is also being gained at Porbandar in the installation and operation of a 6 kW Wind Electric Generator (220 volts DC) presented to the CSIR by the West German Government (Fig. 1). It is hoped that before

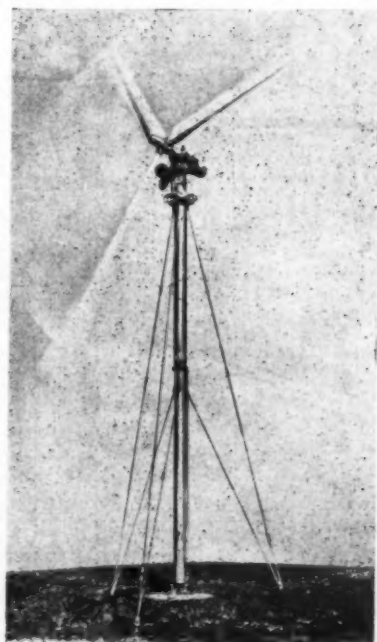


FIG. 1. 6 kW Allgaier wind electric generator with three blades, each 5 metres long.

long similar types of Wind Electric Generators will be designed and constructed by the Laboratory from indigenous materials.

There is no doubt that the Windmill directly pumping water and the small- or medium-sized wind electric generators will be of great use to the large number of villages and for minor irrigation purposes in large tracts of India where there is strong wind, either during most of the year, or at least during those summer months preceding the monsoon when water is most needed.



## SYMPOSIUM ON EXPLOSIVES

**A** THREE-DAY Symposium on 'Explosives' organised jointly by the Explosives Research Development Laboratory, the Institute of Armament Studies, and the Armament Research and Development Establishment, Kirkee, was held on the 15th, 16th and 17th December 1960 at Kirkee.

Fifty-one papers presented at the Symposium were discussed in the three technical sessions. On the first day under the Chairmanship of Dr. R. S. Varma, Director, Defence Science Laboratory, New Delhi, sixteen papers covering the theory, characteristics and applications of propellants were presented and discussed. Dr. A. L. Lovecy of the Ministry of Aviation, U.K., presented an interesting paper on 'Solid Propellant for Rockets'. He gave an outline of research, development and production facilities employed, and discussed the considerations which govern the choice of propellants for evaluation in certain applications. Colloidal (extruded and cast) plastic, elastic and pressed propellants were included in the review providing an impression of their potentialities for current and future designs.

Seventeen papers dealing with Explosives, Primary Explosives and Pyrotechnics were discussed on the second day under the Chairmanship of Dr. H. R. Ambler, Scientific Adviser to the High Commission for U.K. in India. The paper on 'Detonation in Solid Explosives' by Dr. W. M. Evans of the War Office, U.K., evoked considerable interest. Dr. Evans pointed out that detonation processes can in general be observed and measured by optical and by probe techniques because of their highly luminous and ionised nature. With added refinements, associated

processes such as the propagation of shock waves in various inert materials, the projection of scabs or of fragments, can be similarly observed. Flash X-ray techniques are of additional value over the whole field of investigation. Particular mention was made of the techniques used in measuring some of the characteristics of propagation of shock waves in metals and non-metals.

The discussions on the third day mainly consisted of instrumentation and analysis applied to testing of explosives and a few ancillary explosives. Dr. S. K. K. Jatkar, Professor of Chemistry, Poona University, was in the chair and eighteen papers were presented. Dr. H. R. Ambler in his paper on 'Some New Analytical Methods applicable to Explosives' discussed the possibility of using special methods of instrumental analysis such as gas chromatography, chromato-polarography, paper electrophoresis, ultra-violet spectroscopy, thermogravimetry, differential thermal analysis, microscopic chemistry, and the Weisz ring oven in the testing of explosives and explosive products.

Dr. Evans read a paper on "Testing of Equipment for Proper Functioning and Safety in Hot Climates". There was also an interesting discussion on the manufacture of Guanidine nitrate by the 'Ammonium Nitrate Urea' process.

There were two evening lectures: (1) "The Manufacture, Storage and Use of Commercial Blasting Explosives" by Dr. J. C. Hornel, Managing Director, Imperial Chemical Industries (I) Ltd, and (2) "On Organisation of Research for Defence" by Maj. Gen. B. D. Kapur, Chief Controller of Research and Development, New Delhi.

## NEW ZEISS INSTRUMENTS AT THE 1961 TECHNICAL FAIR IN LEIPZIG

**A**S in previous years there will be exhibited this year also at the Technical Fair in Leipzig, on the Zeiss Stand in Hall XV and in the adjoining Zeiss pavilion, a wide range of VEB Carl Zeiss JENA instruments embodying the latest improvements and designs. Many of these instruments will be on show for the first time.

The *Sonovisor 2* (Fig. 1) is an ultrasonic material inspection instrument for the non-destructive testing of metals, porcelain and plastics with regard to cracks, blowholes, pitting or structural changes. The special advantage of this instrument, based on the principle of

the pulse-echo method, is the two-dimensional image presentation by means of the rotary section and vibration section method. The versatile instrument acts as a sort of depth magnifying lens. On correctly setting the brightness and definition of the electron beam, the instrument produces an extremely clear image. Amplification and pulse width can be controlled manually so as to produce the toothed or section image required for testing.

Three new items are introduced in the field of Zeiss Surveying Instruments: (a) The *Theodolite 120* is intended for work of lower accuracy in a wide variety of fields such as



forestry, structural and mining surveying, simple geographical, geological and geophysical tasks; (b) The Reducing Telemeter 006 designed especially for detail surveys with cadastral accuracy will be suitable for such tasks as polar detail surveys, angle measuring of polygonal traverses, architectural surveys,

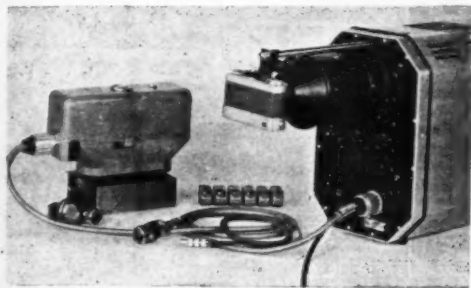


FIG. 1. Instrument for the non-destructive ultrasonic material testing.

civil engineering works; (c) A Meridian Finder (Fig. 2) has been developed for the Theodolite 020, permitting the determination of the astronomical azimuth of a terrestrial target with an average error of approximately  $\pm 1$ .

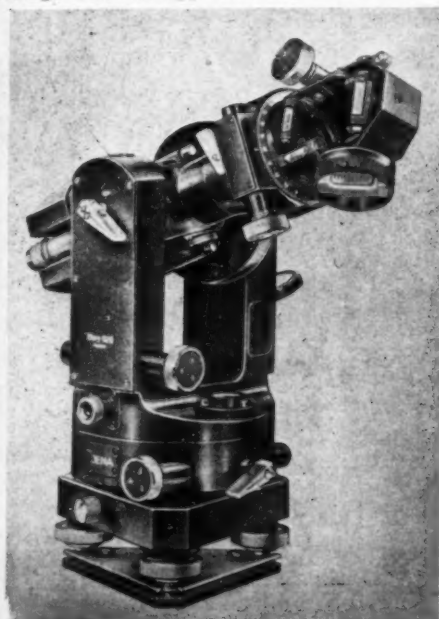


FIG. 2. Tacheometer theodolite "Theo 020" with Meridian Finder.

The range of photogrammetric evaluation instruments of VEB Carl Zeiss JENA has been extended by two new instruments. (a) The Stereometrograph a two-image evaluating instrument for graphical and numerical individual model evaluation of standard and wide angle vertical exposures, (b) The Zeiss Co-ordimeter a programme controlled recording and calculating machine for photogrammetric evaluating instrument, carrying out automatic recording of machine co-ordinates as well as programme-controlled calculations.

Of the new medical instruments, the following deserve special mention: (i) The Electrocymograph an instrument for recording the progression of heart wall movements or lung pulsations during irradiation of the patient with X-rays. (ii) The Separating Chamber for Paper Electrophoresis (Fig. 3) serves for electrophoretic

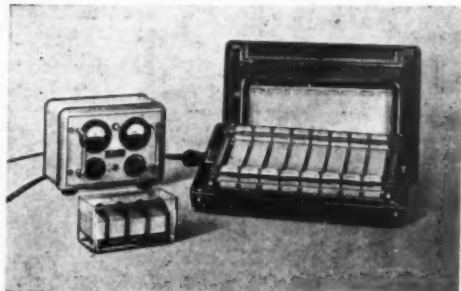


FIG. 3. Separating cell for paper electrophoresis.

separation of colloidal solutions (blood serum) on filter-paper and ensures by uniform test results the reproducibility of the separation tests, and (iii) The Surgical Microscope II which is a stereoscopic surgical microscope for universal application in nose, throat and ear surgery.

The Astro-Division of VEB Carl Zeiss JENA which attained world-wide success by building the 2 m-Universal Reflecting Telescope for the Karl Schwarzschild Observatory, in Tautenburg, introduced two new small astronomical instruments: a powerful astronomical telescope for schools and amateurs with a semi-apochromatic lens AS of 63 mm. internal aperture and 840 mm. focal length, and the Meniscas 150/900/2250 a cassegrain reflecting telescope with a miniscus-shaped entrance lens with polished Cassegrain mirror whose high image quality permits in addition to visual observation, photographs of celestial objects and close subjects from 30 metres distance upwards.

## LETTERS TO THE EDITOR

EFFECT OF ELECTRICAL  
OSCILLATIONS ON THE ELECTRIC  
FIELD IN THE CATHODE DARK  
SPACE OF A COLD CATHODE  
GLOW DISCHARGE

DURING the course of the investigation on the space distribution of the potential in the discharge region of a cold cathode glow discharge, by the electron beam method, it was observed by Warren<sup>1</sup> that the electrical oscillations even when they were present in the plasma region of the discharge, did not have any effect on the field in the cathode dark space.

This interesting result which was observed both for the normal and the abnormal régimes of the discharge can be understood in case of the normal discharge in terms of its voltage-regulating action where an incremental change in the applied voltage  $V_p$  does not change the voltage drop  $V_c$  across the tube but brings about only a change in the discharge current  $I$ , with the result that the incremental voltage is transferred to the load.

As the current density at the cathode also remains constant within the given range of  $I$  (in the case of the normal discharge), there would be a corresponding change in the cross-section due to the change in the applied voltage  $V_p$ . The A.C. signal voltage due to the electrical oscillations superposed on the D.C., should by this argument give rise to a corresponding A.C. component in the cathode current but not in the total voltage across the discharge tube. The absence of the A.C. component in this voltage would naturally mean that the space potentials at the different points in the cathode dark space will have no A.C. component. This conclusion will require a modification if the voltage-regulating action, which is presumably determined by the space-charge effects in the region of the cathode dark space, shows a dependence on the frequency of the superposed A.C. signal.

In order to confirm this conclusion experimentally a variable frequency A.C. signal of strength 7-10 V. peak-to-peak from an A.F. oscillator was injected using a transformer in the circuit of a V/R 105 (specified current range 5-40 m.a.) with a load of 10 K. ohms. The A.C. potential-drop across the tube was measured with a C.R.O., in the frequency range 100 c/s to 100 kc/s. This range represents

the frequency region in which the electrical oscillations in the glow discharge have been generally observed.<sup>2,3</sup>

The results which are shown graphically in Figs. 1 and 2 indicate that for frequencies up to

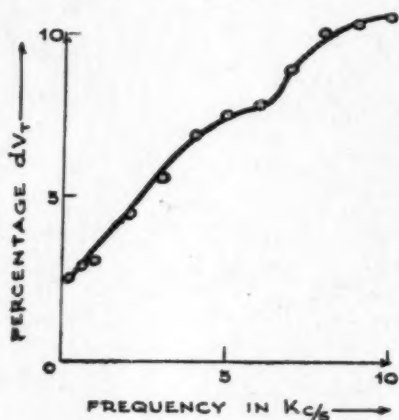


FIG. 1

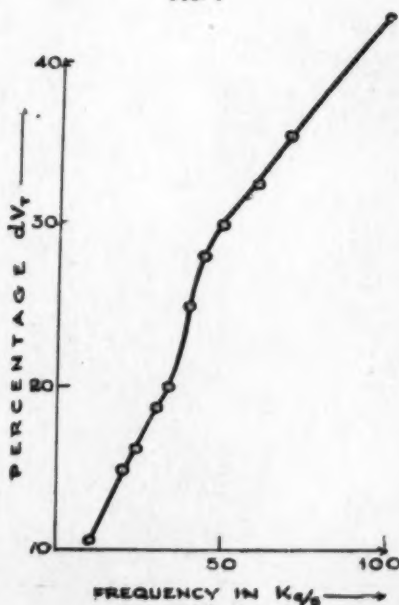


FIG. 2

10 kc, less than about 10% of the input signal appears across the discharge tube. The percentage increases continuously to about 40% at  $f = 100$  kc. The results therefore support the explanation proposed for the observation of Warren.

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Institute of Science, S. S. MANECK.  
Mayo Road, Bombay, January 12, 1961.

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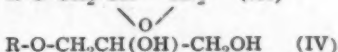
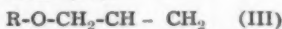
### REACTIONS OF EPICHLOROHYDRIN WITH PHENOLS

In continuation of our previous work<sup>1</sup> on the reactions of epichlorohydrin (I) with amines, we wish to report the results of the condensation of (I) with phenols. Although some work has appeared on this subject,<sup>2</sup> our results are of interest, since the condensation leads to products similar to Mephenisin, which has muscle-relaxing properties.

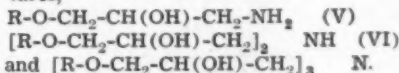
The reaction of (I) with *o*-, *m*-, and *p*-cresols, *p*-chloro and *p*-nitrophenols, and 3:5-xylene-1-ol, in the presence of piperidine hydrochloride gave compounds of the following general formula



By refluxing these compounds over powdered potassium hydroxide in ether solution, the corresponding epoxy compounds were obtained. These epoxy compounds on treatment with dilute sulphuric acid yielded the corresponding diols (IV).






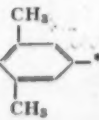


The hydroxychloro (II) as well as epoxy (III) compounds on reaction with ammonia gave rise to a mixture of primary, secondary and tertiary bases having the following structures,



The compounds prepared are listed in Tables I and II.

TABLE I

No.	R-O-CH <sub>2</sub> -CH(OH)-CH <sub>2</sub> Cl		R-O-CH <sub>2</sub> -CH-CH <sub>2</sub> $\diagup \text{O} \diagdown$		R-O-CH <sub>2</sub> -CH(OH)-CH <sub>2</sub> OH	
	Compound R =	b.p./pr	b.p./pr	Analysis	m.p.	Analysis
				Calcd. Found		Calcd. Found
I		190-94°/20 mm.	136-40°/15 mm.	C, 73.2; H, 7.3; C, 73.6; H, 7.1	71-72°	C, 65.9; H, 7.7; C, 65.8; H, 7.8
II		158-70°/20 mm.	136-38°/20 mm.	C, 73.2; H, 7.3; C, 73.5; H, 7.3	66-67°	C, 65.9; H, 7.7; C, 65.6; H, 7.8
III		175-77°/20 mm.	140-42°/15 mm.	C, 73.2; H, 7.3; C, 73.8; H, 7.5	62-65°	C, 65.9; H, 7.7; C, 65.5; H, 7.5
IV		180-84°/20 mm.	146-48°/20 mm.	C, 58.5; H, 4.9; C, 58.7; H, 4.8	Oil	.. ..
V		216-18°/10 mm.	..	.. ..	62-64°	C, 53.3; H, 5.4; C, 53.5; H, 5.3
VI		138-40°/10 mm.	..	.. ..	Oil	.. ..

\* Analysis: Calcd. for C<sub>11</sub>H<sub>13</sub>O<sub>2</sub>Cl, C, 61.5; H, 7.0  
Found C, 61.2; H, 7.3  
Compounds I to V in column I are known.

TABLE II

No.	Compound R=	R-O-CH <sub>2</sub> -CH(OH)-CH <sub>2</sub> -NH <sub>2</sub>				[R-O-CH <sub>2</sub> -CH(OH)-CH <sub>2</sub> ] <sub>2</sub> NH			
		Characterized as	m.p.	Analysis		Characterized as	m.p.	Analysis	
				Calcd.	Found			Calcd.	Found
I		Base	103-4°	C, 66.3; H, 8.3; N, 7.7;	C, 66.5 H, 8.1 N, 7.6	Base	108-10°	C, 69.6; H, 7.8; N, 4.1;	C, 70.0 H, 7.8 N, 4.4
II		Base-HCl	Softens at 131° Clears at 256°	N, 6.4;	N, 6.5	do.	116-17°	N, 4.1;	N, 4.3
III		do.	Softens at 126° Clears at 264°	N, 6.4;	N, 6.5	..	..	..	..
IV		do.	Softens at 172° Clears at 270°	N, 5.9;	N, 6.1	Base	125-27°	N, 3.6;	N, 3.4
V		do.	Softens at 190° Clears at 270°	N, 6.5;	N, 6.6	Base-HCl	128-29°	N, 3.8;	N, 4.0

No.	Compound R=	Characterized as	m.p.	Analysis	
				Calcd.	Found
I		Base-HCl	170-71°	C, 66.5; H, 7.3; N, 2.6;	C, 66.4 H, 7.0 N, 2.6
II		do.	134-35°	N, 2.6;	N, 2.8
III		..	..	..	..
IV		Base-HCl	Softens at 170° Clears at 261°	N, 2.3;	N, 2.5
V		do.	Softens at >125° Clears at 258°	N, 2.5;	N, 2.8

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Bombay-1, A. S. U. CHOUGHULEY.  
November 23, 1960.

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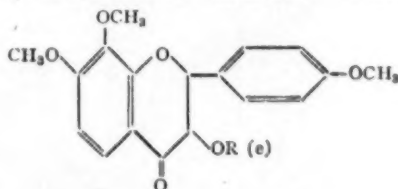
SYNTHESES OF O-TRIMETHYL  
ALLOTERACACIDIN AND  
O-TRIMETHYL ALLOISOTERACACIDIN

CLARK-LEWIS AND MORTIMER<sup>1</sup> recently reported the isolation of new leucoanthocyanidins "Teracacidin" and "Isoteracacidin" from *Acacia intertexta* and have designated them as 7:8:4'-trihydroxyflavan-3:4-diols.<sup>2</sup> These authors have further shown that teracacidin is stereochemically analogous<sup>2,3</sup> with melacacidin<sup>4</sup> ( $C_2: C_3$ -cis,  $C_3: C_4$ -cis) and isoteracacidin is its "4" epimer ( $C_2: C_3$ -cis,  $C_3: C_4$ -trans). The present communication describes the syntheses of their epimers as trimethyl ethers.

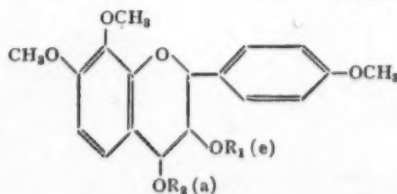
7:8:4'-Trimethoxydihydroflavonol (I), m.p. 174-75° (Found: C, 65.2; H, 5.3;  $C_{18}H_{18}O_6$  requires C, 65.4; H, 5.4%) was prepared by cyclisation of the corresponding acetoxy-chalkonedibromide by Rasoda reaction.<sup>5</sup> The dihydroflavonol (I) was characterised by preparation of its acetate (II), m.p. 116-17° (Found: C, 64.8; H, 5.3;  $C_{20}H_{20}O_7$  requires C, 64.5; H, 5.4%). Hydrogenation of the dihydroflavonol acetate over Raney nickel furnished 7:8:4'-trimethoxy-3-acetoxyflavan-4-ol (III), m.p. 149-50° (Found: C, 64.3; H, 5.9;  $C_{20}H_{22}O_7$  requires C, 64.2; H, 5.9%). 7:8:4'-

121-22° (Found: C, 63.6; H, 5.9;  $C_{22}H_{22}O_8$  requires C, 63.5; H, 5.8%), which was identical with the one obtained on acetylation of the diol (IV). The dibenzoate (IV), m.p. 151-52° (Found: C, 70.8; H, 5.2;  $C_{32}H_{28}O_8$  requires C, 71.1; H, 5.2%), of the diol (IV) was prepared for comparison with the dibenzoate of the other diol, 7:8:4'-Trimethoxydihydroflavonol (I) on reduction with lithium aluminium hydride gave a mixture of flavan-3:4-diols isomeric in position "4". The mixture had melting range 85-100° and was extremely difficult to separate. However on repeated crystallisations another diol (VII), m.p. 155-56° (Found: C, 65.4; H, 5.9;  $C_{18}H_{20}O_6$  requires C, 65.1; H, 6.0%), was obtained in poor yield together with the diol (IV). The diol (VII), m.p. 155-56°, was characterised by preparing its dibenzoate (VIII), m.p. 175-76° (Found: C, 71.4; H, 5.5;  $C_{32}H_{28}O_8$  requires C, 71.1; H, 5.1%). Both the diols (IV) and (VII) gave violet colour with concentrated sulphuric acid and pink colour,<sup>6-9</sup> characteristic of anthocyanidin formation, on warming with alcoholic hydrochloric acid.

On the basis of postulates of Joshi and Kulkarni<sup>10</sup> 7:8:4'-trimethoxyflavan-3:4-diols



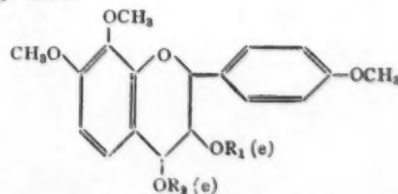
I R = H m.p. 174-75°  
II R = COCH<sub>3</sub> m.p. 116-17°



Alloteracacidin (IV)

IV	$R_1 = R_2 = H$	m.p. 125-26°
III	$R_1 = COCH_3, R_2 = H$	m.p. 149-50°
V	$R_1 = R_2 = COCH_3$	m.p. 121-22°
VI	$R_1 = F, R_2 = COC_2H_5$	m.p. 151-52°

Trimethoxy-3-acetoxyflavan-4-ol on hydrolysis gave 7:8:4'-Trimethoxyflavan-3:4 diol (IV), m.p. 125-26° (Found: C, 65.4; H, 6.4;  $C_{18}H_{20}O_6$  requires C, 65.1; H, 6.0%). 7:8:4'-Trimethoxy-3-acetoxyflavan-4-ol on acetylation gave the diol diacetate (V), m.p.



Alloisoteracacidin (VII)

VII	$R_1 = R_2 = H$	m.p. 155-56°
VIII	$R_1 = R_2 = COC_2H_5$	m.p. 175-76°

(IV) m.p. 125-26° and (VII) m.p. 155-56° have been assigned 2:3-trans-3:4-cis and 2:3-trans-3:4-trans configurations respectively and have been designated as "Alloteracacidin" and "Alloisoteracacidin".



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Institute of Science, A. B. KULKARNI.  
Bombay-1, December 5, 1960.

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#### THE UPTAKE AND REDUCTION OF BROMATE BY WHEAT-ROOTS

WITHIN the framework of our research programme the uptake, metabolism and the effect of the different haloid and halogenate ions on higher plants are being systematically studied. Investigations are being made with the object of comparing the special characteristics of their uptake on the one hand, and, on the other hand, we aim at clarifying the mechanism of their toxicity. With regard to the bromate, Aberg<sup>1</sup> pointed out that the toxicity stems from the reductions of bromate taking place in the plants. As far as we know no one has made use of the possibility afforded by radioactive isotopes to study this reduction of bromate, apart from the determination of the transformation taking place in the baking of bread.<sup>4</sup>

In order to investigate bromate uptake and reduction we used  $\text{Br}^{82}$  isotope which had been obtained through the Isotope-Distribution Institute of the National Atomic Energy Commission from the reactor of the Central Physical Research Institute in the form of KBr solution. At the time of delivery the activity of the solution was 1.66 mC./ml., containing 2.5 mg. KBr per millilitre. There was no radioactive contamination to be detected in the solution, but a considerable amount of  $\text{Br}^{80}$  was found at this stage. The latter, because of its shorter half-life, decayed before the experiments.

The electrolytic oxygenation method described by Lee *et al.*<sup>4</sup> was employed to produce bromate. A micro test-tube was used to function as the electrolytic cell in which two platinum plate-electrodes had been placed with a distance of

about 3 mm. between them. 250 mg. KBr, 0.4 ml. of 0.1 N HBr and 0.2 ml. of 1%  $\text{K}_2\text{Cr}_2\text{O}_7$  solutions were added to 1 ml. of radioactive solution and the electrolysis was made with about 2.3 volts at 60 mA for 12 hours. For reasons of safety the apparatus had been placed inside a series of gas wash-bottles which were aerated, but this proved to be unnecessary since no radioactive gas developed.

The crystals formed were purified by means of recrystallization until the colour of the bichromate was no longer evident. At the end of the process 140 mg.  $\text{KBr}^{82}\text{O}_3$  was obtained from which solutions were made with a concentration of 1 ml. equiv./l. to be used in the experiments.

Each experiment lasted for 6 hours and was made with excised wheat-roots and the method adopted was similar to the one described when studying iodate reduction.<sup>3</sup> There was an alteration in the method of extraction of the radioactivity taken up. Based on some of our earlier experiments we came to the conclusion that  $\text{Br}^{82}$  could more easily be extracted from plants than  $\text{I}^{131}$  and that practically there was no detectable activity to be found after the alcoholic-distilled water extraction. So the residue was not investigated in these experiments.

Samples were made from aliquots of the alcoholic-water extract and their activity was measured by means of an 1.3 mg./cm.<sup>2</sup> end-window GM-tube, and from another part chromatograms were made in the same way as has been described in our earlier papers<sup>2,3</sup> and autoradiograms were taken from these. The distribution of the activity on the chromatogram strips was also determined with an 1.5 mg./cm.<sup>2</sup> end-window GM-tube by using 1 cm. diaphragm.

The activities measured were compared with those made from the original KBr and  $\text{KBrO}_3$  solutions and both of these were measured simultaneously.

The variants used in the experiments were as follows: (1) 1 m. equiv./l.  $\text{KBrO}_3$ ; (2) 1 m. equiv./l.  $\text{KBrO}_3 + 10^{-3}$  Na-azide; (3) 1 m. equiv./l.  $\text{KBrO}_3 + 50$  m. equiv./l.  $\text{KNO}_3$ ; (4) 1 m. equiv./l.  $\text{KBrO}_3$  with roots killed by boiling; and (5) 1 m. equiv./l. KBr.

The uptake of the bromate is lower than that of the bromide, but the rate of uptake is comparable. It should be noted that in wheat-roots the bromide has the higher rate of uptake of all halide ions. Attention should be paid to the extent to which the Na-azide inhibits, surpassing the azide inhibition detected in iodate

TABLE I

Bromate and bromide uptake by wheat roots

Variant	Uptake in $\mu$ equiv.	Uptake as % of control
1. $\text{KBrO}_3$	.. 0.70	100
2. $\text{KBrO}_3 + \text{Na-azide}$	.. 0.047	6.7
3. $\text{KBrO}_3 + \text{KNO}_3$	.. 0.47	67
4. $\text{KBrO}_3$ with roots boiled	.. 0.16	22
5. $\text{KBr}$	.. 1.21	..

uptake.<sup>3</sup> Meanwhile the inhibitive effect of the nitrate is lower than in the case of the iodate. Boiled roots seem to have "absorbed" a certain quantity of radioactivity as was seen in the iodate experiments too. As expected this "absorption" is lower. The autoradiogram of the chromatogram and the GM-tube measurements indicate that a large proportion of the bromate taken up transforms into bromide (Fig. 1). The reduction is equal to about 75% of the absorbed quantity. The chromatograms have failed to point to the formation of organic compounds in the plants either from the bromide or bromate. For the sake of comparison the chromatogram strips made from the original bromide and bromate solutions are given in Fig. 1. It is worth mentioning that no detect-

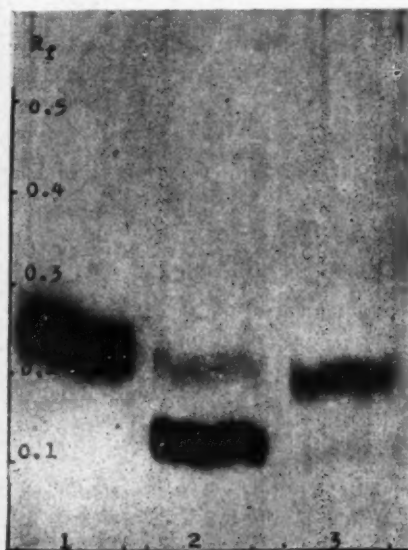


FIG. 1. The radioautogram of the chromatogram, (1) and (2) bromide and bromate outer solutions and (3) the extract of roots after uptake of bromate.

able change was to be found in the composition of the outer solution during the 6-hour experi-

ments. It can be concluded that the bromate, as well as the iodate, is reduced in the roots of higher plants, but unlike the iodate the reduction does not lead to the formation of organic Br-compounds.

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and Central Biological  
Isotope Laboratory,  
Eötvös University,  
Budapest, February 20, 1961.

Z. BOSZORMENYI,  
EDITH CSEH,  
B. JAMBOR.

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### FINGER-TIP PATTERNS OF THE CAR NICOBARESE

THE present note gives a short account of the dermatoglyphics of the fingers of the Car Nicobarese, a Mongoloid people, and inhabitant of Car Nicobar. This island, which belongs to the Nicobar group of islands, is situated between 93° longitude East and 9° latitude North.

No data on dermatoglyphics of this particular people have hitherto been published. Out of 130 finger-prints from male individuals, 128 prints are available for classification of pattern types. The rest two prints could not be deciphered for their incomplete impressions. Arch-loop-whorl classification of Galton has been followed and the results are listed in Table I.

TABLE I

Percentile frequencies of pattern types in 128 digits

Hands	Whorls	Ulnar loops	Radial loops	Arches
R ..	36 (57-14)	26 (41-27)	1 (1-59)	..
L ..	33 (50-77)	30 (46-15)	2 (3-08)	..
Both ..	69 (53-91)	56 (43-75)	3 (2-34)	..

Table I shows that the arch is completely absent in the Car Nicobarese. Most probably the lacking of this pattern type is due to chance or due to the small size of the sample, as arches compared with other apical patterns occur very less (0.8 to 3.0%) in different Mongoloid peoples.

The author expresses his thanks to Shri N. Shyam Choudhury, Anthropologist, who collected these prints and to Dr. A. K. Mitra, the then Deputy Director, Department of

Anthropology, Government of India, who made them available to the author for analysis.

Dept. of Anthropology, P. N. BHATTACHARJEE,  
Govt. of India, Indian Museum,  
Calcutta-13.

December 23, 1960.

# A NEW RECORD OF THE ANCHOVY *THRISSOCLES VITIROSTRIS* GILCHRIST AND THOMPSON FROM INDIAN WATERS\*

OF the fourteen described species of the anchovy, *Thrissocles* Jordan & Evermann, twelve have so far been recorded from Indian waters (Misra<sup>1</sup>). Of these, *T. mystax* Schneider, *T. dussumieri* Cuv. & Val., *T. setirostris* Broussonet, *T. malabaricus* Bloch, and *T. hamiltoni* Gray have been identified off Waltair coast. The last two are comparatively rare. A careful examination of the meristic characters of the local anchovies has revealed that a sixth species, *T. vitirostris* Gilchrist & Thompson (Fowler<sup>2</sup>), previously reported only from southern African waters, also occurs locally.

*T. vitirostris* G. & T. closely resembles *T. mystax* Schn., and in fact could be mistaken for the latter: in both species the maxillary extends to a little beyond the base of the pectoral fin, and many of their body proportions overlap. *T. vitirostris* however can be easily identified by opening the gape of the mouth wide—the gill arches are bright orange-coloured, and the relatively large number of gill-rakers (vide below) is immediately noticeable.

The distinguishing characters of *T. vitirostris* G. & T. are: Height (Depth)  $3\frac{3}{5}$ - $3\frac{4}{5}$ ; Head  $3\frac{3}{5}$ - $4\frac{1}{5}$ ; Snout in Head  $4\frac{3}{5}$ - $5\frac{1}{5}$ ; Eye in Head  $\frac{1}{2}$ - $\frac{3}{4}$ . Eye greater than snout.

The range in the meristic characters of *T. mystax* Schn. and *T. vitirostris* G. & T. from Waltair is given below:

	<i>T. mystax</i> n=98	<i>T. vitirostris</i> n=25
Ventral scutes	16-18 + 9-11	16-18 + 10-12
Dorsal ..	14-16 M=14.95	13-15 M=14.00
Anal ..	25-40	25-40
Pectoral ..	11-14 M=12.56	12/15-M=12.40
Gill-rakers	9-1 + 14-17	15-17 + 10-23
Vertebrae	44-46 M=45.01	45/46 M=45.06

The difference in the number of gill-rakers is significant; further, although the gill-arches are orange-coloured in both species, the colour is deeper and more bright in *T. vitirostris*.

There is also a significant difference in the means of the dorsal fin rays.

This is the first record of *T. vitirostris* G. & T. from Indian waters. Smith<sup>3</sup> considers this species as a synonym of *T. malabaricus* Bl., and described it under the latter name, but the description and figure given by him indicate that the species recorded by him is not *T. malabaricus* Bl. [because the latter species is much broader (Fowler, op. cit.), and the maxillary hardly extends beyond the opercular opening, whereas he clearly states that the "maxilla reaches barely beyond pectoral base"]. The species described by him may be *T. vitirostris* G. & T. because the raker number given by him (21-25) is in general agreement with that given by Fowler (21-24) for the species from the same region, but then he gives the number of anal fin rays as 40-43, whereas Fowler gives it as 38-40, and in the forms from Waltair it ranges between 35 and 40.

Detailed studies on the seasonal distribution, biometry, length frequency and growth rate, and spawning of *Thrissocles* spp. of Waltair coast are in progress, and the results will be published elsewhere.

The author expresses his grateful thanks to Prof. P. N. Ganapati, for valuable suggestions and for kindly going through the manuscript.

Department of Zoology,  
Andhra University,  
Waltair, December 3, 1960.

S. DUTT.

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- \* Since the communication of this note, the author has observed *T. vitirostris* in catches obtained from Kakinada and Mangalore.

## EFFECT OF INITIAL MOISTURE CONTENT OF DIFFERENT FOOD MATERIALS ON DEVELOPMENT AND SEX RATIO IN *CORCYRA CEPHALONICA* STANTON

RAO (1954)<sup>1</sup> studied, among other things, the influence of the quality of larval food on the length of developmental period and on the sex of the emerging moths of *Corcyra cephalonica* Stainton. He also observed the effect of removal of free water from food material on the development of *Corcyra*, but he did not devote attention to a study of the effect of various types of food in which there was a higher moisture content than the normal. The present studies were undertaken to see the effect of higher

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moisture content in the food on the develop-  
mental period and the sex ratio.

One hundred and fifty grams of broken  
grains of 'Jowar' (Sorghum), groundnut,  
cowpea, rice, wheat and maize with 9% and  
12% moisture content of each, were separately  
kept in small glass troughs and six newly  
hatched first instar larvæ of *Corcyra cephalonica*  
were introduced in each of the above troughs  
on the same day. There were three replications  
for each type of moisture content in all the  
foods. The test insects were bred exclusively  
in the laboratory from a single pair of *Corcyra*  
moths. The dates of emergence of the first moth  
and of the subsequent emergences of moths  
together with their sexes were recorded. These  
studies were conducted in the laboratory at an  
average temperature of  $92^{\circ}\text{F} \pm 5^{\circ}\text{F}$ . with an  
average relative humidity of 40%. From the  
observations recorded in Table I, it may be

TABLE I

Development of *Corcyra cephalonica* Stainton  
in various food materials having different  
moisture contents

Food materials	Initial moisture content %	* Average life-cycle period in days	* Average percentage of females
Broken 'jowar' grains	9 approx.	50.6	44.4
	12	47.0	61.1
Broken groundnut seeds	9	59.0	27.8
	12	53.6	44.4
Broken cow-pea seeds	9	61.3	16.7
	12	63.0	22.2
Broken rice (coarse and white)	9	48.0	61.1
	12	44.6	61.1
Broken wheat	9	52.0	38.9
	12	48.0	44.4
Broken maize seeds	9	54.0	38.9
	12	50.6	44.4

\* Average of 3 replications.

seen that, on the whole, coarse, white rice was  
the best food where the minimum time was  
taken for the development (48.0 days with 9%  
moisture content and 44.6 days with 12%  
moisture content on an average) while, in cow-  
pea, it took the maximum time for the insect  
to develop (64.3 days with 9% and 63.0 days  
with 12% moisture content respectively). The  
higher of the two moisture contents namely,  
12%, was found in every case to be the most

conducive to development. The highest average  
percentage of females (61.1%) was obtained  
in rice under both moisture contents and the  
lowest ratio was in cow-pea, namely, 16.7%  
and 22.2%, respectively, with 9 and 12%  
moisture contents. It was further observed that  
an initial moisture content of 12% was, on the  
whole, favourable for the production of larger  
number of female moths in all the food  
materials tried except in the case of coarse  
rice where the sex ratio of the male and female  
moths was 50 : 50.

The author is grateful to Dr. E. S. Narayanan,  
Head of the Division of Entomology, for his  
interest in this work.

Division of Entomology, SNEHAMOY CHATTERJI,  
Indian Agricultural  
Research Institute,  
New Delhi-12, June 23, 1960.

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#### STUDIES ON THE TRANSLOCATION OF RADIOACTIVE SCHRADAN IN PLANTS AND ITS UPTAKE FROM FILM BY INSECTS

OCTAMETHYL pyrophosphoramidate (schradan)  
has been recognised as a systemic insecticide.  
Ripper *et al.*<sup>1</sup> and Greenslade<sup>2</sup> showed  
that it had a mild contact toxicity also,  
whereas Duspiva<sup>3</sup> indicated that its contact  
action was quite strong on some sucking  
insects. In view of its potentialities the  
present studies were undertaken to examine its  
systemic as well as its contact action by using  
P<sup>32</sup> labelled schradan. The translocation of  
schradan was also studied. The study was  
carried out in two different ways. In the first  
case, 5 ml. of 0.5% solution of radioactive  
schradan was mixed with 30 ml. of standard  
culture solution. The cotton-seedlings were  
dipped in the radioactive solution thus  
prepared for periods of 10, 20, 30 and  
40 minutes respectively, after which they were  
transferred to normal culture solutions. In the  
second case, 100 ml. of 0.25% solution of  
radioactive schradan was used to irrigate cotton  
and sugarcane plants grown in earthen pots. It  
was observed that schradan was translocated  
to the leaves in cotton-seedlings even with a  
10 minutes dip in its solution and stayed there  
at least for 10 days, for which period the  
experiment lasted. The radioactivity of the  
leaf was found to increase for the first four



days, the maximum effect being found on the fourth day, after which it started declining. On the other hand, in the irrigation method it was noted that the rate of translocation of schradan was quicker for the first two days in cotton plants but more or less uniform in sugarcane plants, being maximum on the seventh day in both cotton and sugarcane plants after which it started to decline. It is concluded that radioactive schradan is absorbed by the roots of the plant and is translocated to other parts of the plant, the rate of translocation varying from species to species of plants.

Trials were also made to study the uptake of schradan from film by insects. For this purpose, two series of experiments were laid out. In one set of the first series, 30 nymphs of *Dysdercus koenigii* Fabr. were pretreated at 38° C. for two hours and then released over filter-paper which had been previously soaked in 1 ml. of 0.5% solution of radioactive schradan and dried under an infra-red lamp. The activity of the test insects was assayed after 24 hours. It was observed that all the *Dysdercus* nymphs were dead on the fourth day. In the second set, 40 nymphs of *Dysdercus* were released on filter-papers soaked in the same proportion and concentration as in the first set and then exposed to 38° C. for 20 hours along with the treated filter-papers. It was observed that all the *Dysdercus* nymphs were dead on the second day.

In one of the sets of the second series of experiments, 20 adults of *D. koenigii* were exposed to film of 0.5% solution of schradan and kept at temperatures of 38° C., 35° C. and 30° C. for 24 hours. The treated insects were then kept at room temperature as such. In the other set, 20 adults of *D. koenigii* were exposed to film of 0.5% solution of radioactive schradan and kept at temperatures of 30°, 25°, 20° and 15° C. for 24 hours. The test insects were then removed to clean containers and kept at the above temperatures. The observations confirmed that schradan, though a systemic insecticide, was also picked up by the insects from film in considerable quantities. Both the dead and living insects were assayed, as a result of which the pick-up of the insecticide from the film was definitely confirmed. The uptake of the insecticide also apparently increased with the rise in temperature.

The authors wish to express their gratitude to Dr. S. Pradhan, Professor of Entomology, for supervision and helpful suggestions,

Division of Entomology, SNEHAMOY CHATTERJI.  
Indian Agricultural Research Institute, G. W. RAHALKAR.  
New Delhi-12, G. R. SETHI.  
June 23, 1960. P. N. SAXENA.

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### A SINGLE VALUE MEASURE FOR SOIL TEXTURE

MANY physical properties of soil are often expressed by single value constants. As most of these properties are ultimately related to the colloidal content, these numerical values may be taken as indexes of the texture of the soil. There is, however, no suitable constant for directly expressing the soil texture. Summation curve gives an idea of the mechanical composition but it does not indicate by a single numerical figure the exact textural class of the soil.

Whittles (private communication) has recently suggested a simple method of expressing the soil texture by a single value "y". It is calculated by first drawing the summation curve of the soil from the values of individual fractions raised arithmetically so that they total 100, expressing the area lying below the curve as a percentage 'a' of the total area of the rectangle and then calculating the value 'y' as

$$y = \log c + \log (c-a) - \log (100 - c)$$

where *c* is the arithmetically raised percentage of the clay on the international system. A higher value of "y" indicates a heavy soil with high clay content, and a lower value shows a light soil in which sand fraction predominates.

The validity of this was tested on a large number of Indian soils of different classes, with wide variation of texture. The different textural classes of these soils according to the triangular diagram of Prescott and their corresponding "y" value limits found, are given in Table I.

TABLE I

Textural classes of soils	'y' value
Sand	.. up to 0.08
Loamy sand	.. 0.18-0.62
Sandy loam	.. 0.47-0.96
Loam	.. 0.63-0.98
Silty loam	.. 0.81-1.17
Clay loam	.. 0.95-1.25
Silty clay loam	.. 1.25-1.44
Clay	.. 1.04-1.72



Although the "y" value overlaps in some cases, on the whole it gives a fair expression of the soil texture.

I.A.R.I.,  
All-India Soil & Land Use Survey,  
Nagpur, September 24, 1960.

B. B. Roy.

selective pesticides that are relatively less harmful to biological control agents and tends to reduce insecticidal treatments to the minimum required to control the specific pest.

Indian Agricultural  
Research Institute,  
New Delhi,  
September 23, 1960.

T. V. VENKATRAMAN,  
C. L. DHAWAN,  
K. O. RACHIE.

### A SERIOUS OUTBREAK OF THE SUGARCANE MITE ON JOWAR

RECENTLY a severe outbreak of the sugarcane mite, *Oligonychus indicus*, occurred in the jowar experimental plots of the Botany Division at the Indian Agricultural Research Institute. The mites multiplied so rapidly that within a very short time they had spread over a large area and even week-old seedlings were heavily attacked. Dwarf exotic varieties appeared to suffer the greatest damage. Some border rows of the exotic hybrid RS 610 had turned reddish-brown as the leaves dried up under heavy attack by this pest. The undersides of the leaves were covered by mites and their webbing with initial attack occurring in spots near the midrib and spreading throughout the length and breadth of the leaf.

Warm dry weather conditions during the first week of September had provided ideal conditions for mites. Heavy monsoon rains had prevented an earlier build-up of this pest. Under optimum conditions, and in the presence of a plentiful supply of host plants, the mite multiplied unchecked, and resulted in a 'biotic explosion'. A close examination of the affected plants revealed the absence of an important biotic factor usually found associated with the mite. The beneficial lady-bird beetle (*Stethorus pauperculus*), which often follows closely the mite and helps to keep this pest in check, was not found in the field. During 1958 and 1959 this predator was observed to effectively control outbreaks of mite attack. This was pointed out recently by one of the authors (Venkatraman<sup>1</sup>). The serious outbreak of mites during the present season may be partially attributed to the effects of frequent insecticidal applications on natural parasites and predators.

It is possible that the continued reliance on a complex chemical control programme for a number of years over a large area not only causes an immediate upset of the natural balance but may also result in semi-permanent changes. Insects or mites not ordinarily considered problems could develop into major pests. Thus, consideration should be given to a control programme that harmonizes biological and chemical methods and which attempts to utilize

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### RECORD OF *HELICOSTYLUM* *PYRIFORME*, BAINIER ON SUGARCANE IN INDIA

A MUCORACEOUS fungus was isolated from living sugarcane sheath in one of the fields at Udamalpet in November 1958. It grew readily on neutral oat meal agar producing a highly branched mycelium with rhizoids and an abundance of asexual reproductive structures.

The fungus when grown on Czapek-Dox solution with maltose or glucose replacing sucrose develops a deep olive buff mycelium. The substrate mycelium is highly branched and sporangiophores are borne singly arising not only from the points of origin of the rhizoids but elsewhere also. They are up to 2 cm. in length and fertile at the tip as also at a number of points (2-4) along the length where swellings are present at the point of origin of branches. Branches are short, dichotomous, rarely trichotomous. Pedicels arise at the tips of these branches. The nodal swellings are borne generally in a verticillate manner. Pedicels are straight but sharply curved towards the apex so that the sporangiole is reflexed on the pedicel (Fig. 1). The sporangiole is obpyriform, hyaline, smooth-walled with a dome-shaped columella. Sporangioles bear 20 or more spores. They get detached along with the greater part of the pedicels. They have been rarely observed to dehisce by an irregular apical tear. The apical cluster of sporangioles develops first followed by a downward development at intervals. Downwards the arrangement of sporangioles is to a side of the sporangiophore instead of verticillate. The pedicels are 42.0-105.0  $\mu$  in length, the sporangiole 15.9  $\times$  33.6-13.4  $\times$  22.7  $\mu$  in size, and the spores 4.8  $\times$  5.0-2.4  $\times$  4.0  $\mu$  in size.

In neutral oat meal agar medium the tip of the sporangiophore was always noticed to bear a cluster of pedicels bearing sporangioles. In strongly acidified medium and under certain conditions of starvation of medium, the sporangiophore tip instead of bearing a cluster of

sporangioles ends in a single, large, globose sporangium (Fig. 2). The sporangium in certain cases lacks a columella.

**HELICOSTYLUM PYRIFORME, BAINIER**



FIG. 1



FIG. 2

FIG. 1. Typical sporangiophore with sporangiola.  
FIG. 2. Sporangiophore showing single terminal sporangium and verticillate cluster of pedicels below.

Zygospore formation has not been observed.

The fungus has been identified as *Helicostylum pyriforme*, Bainier. This appears to be the first record of its occurrence in India and on sugarcane.

According to the description given by Hesseltine for *Thamnidaceae*,<sup>1</sup> the terminal sporangium is columellate while sporangioles are without a well-developed columella. His separation of the genus *Helicostylum* is on the basis of the presence of the terminal sporangium. In the present case the formation of the terminal sporangium appears to occur under special conditions. The occurrence of columella also appears to be a variable character. Hence the usefulness of these characters as taxonomic criteria for separation of the genera in the family, may have to be reconsidered.

Thanks are due to Shri K. V. Srinivasan, Mycologist, Dr. C. V. Subramaniam, Professor of Plant Pathology, Indian Agricultural Research Institute, New Delhi, Dr. C. W. Hesseltine of U.S.D.A. and Dr. J. J. Elphick of C.M.I. for help in identification of the fungus. Thanks

are also due to Dr. J. T. Rao, Botanist, for interest and encouragement.

Sugarcane Breeding Inst., U. VIJAYALAKSHMI,  
Coimbatore-7, September 28, 1960.

1. Hesseltine, C. W., *Mycologia*, 1955, 47, 334.

**DETERMINATION OF TOTAL SOLUBLE  
SALTS IN THE BLACK CLAYEY  
SOILS OF ANDHRA PRADESH BY  
CONDUCTIVITY METHOD**

MEASUREMENT of electrical conductivity of soils offers a simple and rapid method for the determination of total soluble salts. The U.S.D.A.<sup>1</sup> has advocated the use of the measurement of electrical conductivity of saturation extracts at 25° C. and then calculating the total soluble salts in soils by using an equation. However, our experience has been that it is difficult to ascertain the precise point of saturation by the criteria prescribed such as glistening of paste as it reflects light, sliding of the paste cleanly off the spatula, etc. (loc. cit.). According to Reitemier<sup>2</sup> use of conductivity of soil paste appears to be unreliable due to the factors like variation in saturation percentage, lack of cell constant for cups, etc. For these reasons Piper<sup>3</sup> used 1:5 soil-water extract for measuring the electrical conductivity of Australian soils. He suggested the following equation for calculating the total soluble salts from the electrical conductivity of the soils.

$$T.S.S. = 375 \times EC$$

where T.S.S. = % total soluble salts in soils, and EC = electrical conductivity in mhos/cm. of 1:5 soil extract at 20° C.

The factor connecting EC with T.S.S. varies from one soil group to another. In the Sudanese soils Joseph and Martin<sup>4</sup> found the factor to be 250 at 30° C. and 300 at 25° C.

Due to these reasons, the exact relationship between the EC and T.S.S. in the black-clayey tobacco soils of Andhra Pradesh was sought to be determined in the present work.

202 soil samples collected from Ongole and Bapatla Taluks of Guntur District were used in the present study. The EC of 1:5 soil extract was determined using Philips conductivity bridge. The T.S.S. in these soils were determined by the gravimetric method.

It was found that the T.S.S. could be determined by the following equation with a high degree of accuracy.

$$(\%) \cdot T.S.S. = 0.290 \times x + 0.014$$

where,  $x$  = electrical conductivity of 1:5 soil extract at 25° C. in millimhos/cm.

The correlation coefficient between the total

soluble salts and conductivity was 0.89 and it was highly significant.

The authors are thankful to Dr. G. S. Murty, Director, for his keen interest and to Sri. M. V. Pavate, Statistician, for working out the statistical correlations.

B. V. KAMESWARA RAO.  
A. S. SASTRY.

Central Tobacco Research Inst.,  
Rajahmundry, October 7, 1960.

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### MULTIPLE ALLELISM FOR PETAL COLOUR IN *LINUM GRANDIFLORUM* DESF.

*Linum grandiflorum* Desf. is an ornamental plant. The varieties popular with the floriculturists possess flowers with different shades of red colour. These are var. *rubrum* with bright red flowers, var. *kermesinum* with crimson flowers and var. *coccineum* with scarlet flowers (Bailey, 1929). At this Division, a seed sample received from the Economic Botanist (Oilseeds), Kanpur, U.P., was found to give plants with red, pink and white flowers. Pure breeding red and white types were isolated from this material and the pinks invariably segregated for the three floral types in their progeny. At Nilokheri (Punjab), a solitary off-type plant, in a bed of over 2,000 plants of red flowered type, was observed by one of us (P. L. G.) to possess orange flowers, a colour hitherto not reported in the species. Red, orange and white types were intercrossed to study the mode of inheritance of flower colour. Maintenance of parental types, as also the rearing of  $F_2$ 's, was done by sibbing owing to limitations imposed by self-incompatibility associated with heterostyly in the species (Lewis, 1943). The genetic data are tabulated in Table I.

TABLE I

Cross	$F_1$	$F_2$	$\chi^2$ 1:2:1 or 3:1	P
Red x White ..	Pink	45 red 86 pink 33 white =164	2.1462	0.30-0.50
Red x Orange	Red	225 red 75 orange =300	0.0	1.0
White x Orange	Pink	Has not been studied so far	..	..

It will be seen that red is partially dominant over white and fully dominant over orange. Orange is probably partially dominant over white. The crosses red x white and red x orange show monogenic segregation. It appears, therefore, that the same locus is involved in the development of the three petal colours—red, orange and white—in this species.

Division of Botany, A. B. JOSHI.  
Indian Agricultural Research M. W. HARDAS.  
Institute, New Delhi, P. L. GUGLANI.  
October, 6, 1960.

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### NEW HOST PLANTS OF THE TOP-SHOOT BORER OF MAIZE (*CHILO ZONELLUS* SWIN.)

THE top-shoot borer, *Chilo zonellus*, Swinhoe (Pyralidae; Lepidoptera), is known to be a serious pest of maize, jowar and sugarcane. Fletcher and Ghosh<sup>1</sup> have reported that this borer also attacks bajra (*Pennisetum typhoides*), rice, *manduwa* (*Eleusine coracana*), Sudan grass (*Sorghum vulgare* var. *sudanense*) and Job's-tears (*Coix lachrym-jobi*). Trehan and Butani<sup>2</sup> pointed out two additional host plants of this pest, namely, Johnson grass (*Sorghum halepense*) and Burgur (*Polytoca barbata*). Up-to-date eleven different host plants have been recorded. The pest appears to have a wide host range and a review of literature indicates that it has so far been reported to occur only on monocotyledonous plants.

During the 1960 kharif season, an experiment was laid out at the Indian Agricultural Research Institute, to study the comparative damage caused by *Chilo zonellus* at different dates of planting and to study resistance of inbred lines of maize to the pest.

A careful study of the weeds growing around these plants and in the field revealed the presence of egg masses of *Chilo zonellus* on their leaves. The weeds showing the egg masses were *Eragrostis* sp. and *Eleusine verticillata* (both monocotyledonous weeds) and *Trianthema monogyna* (a dicotyledonous weed).

The egg masses were collected from the weeds and were studied along with the larvae that hatched from them. They were found to be those of *Chilo zonellus*. Maize plants were then inoculated with these larvae and the characteristic dead-heart symptoms were

recorded. This observation further confirmed that the larvæ were those of *Chilo zonellus*.

It, therefore, appears that *Chilo zonellus* has a wider host range, embracing even the dicotyledonous plants. The present record constitutes the first report on a dicotyledonous plant being a host of this pest. The observations reported here provide evidence to the effect that a certain amount of infestation in maize plants in the fields can take place via the egg masses and larvæ of *Chilo zonellus* present on the weeds mentioned above. It may be added that the three weeds, namely, *Eragrostis* sp., *Eleusine verticillata* and *Trianthema monogyna*, occur widely in the maize fields in the north-western plains of India.

Division of Botany,  
Ind. Agri. Res. Inst.,  
New Delhi-12,  
October 24, 1960.

JOGINDER SINGH.  
N. L. DHAWAN.  
A. B. JOSHI.

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#### SPHAEROPSIS KNOTS ON LIME (*CITRUS MEDICA* VAR. *ACIDA* LINN.) IN RAJASTHAN

DURING the month of February, 1960, a few lime (*C. medica* var. *acida* Linn.) plants in an orchard in Ajitgarh (Rajasthan) were found to have developed knots on certain branches which gave witches' brooms appearance (Fig. 1). Such knots have been attributed to the fungus *Sphaeropsis tumefaciens* by Hedges (1911), who reported this disease first on lime trees from Jamaica. Later on, the disease was also recorded from Egypt, British Guiana, Peru, Dominica and the Hawaiian Islands. Since it does not seem to have been reported from any part of India, an annotated account of the symptoms and the fungus associated with it, is presented in this paper.

In early stages, the disease is manifested by the occurrence of hard woody, rounded or irregularly shaped knots on the branches, attached by a broader base, girdling them. They vary in size from a pea grain to 2-3 inches in diameter (Fig. 2). The young ones are covered by smooth green bark. In later stages, they enlarge resulting in the splitting of the bark and, become light brown in colour, deeply furrowed and rough. The bark is killed ultimately and the discoloration of wood also takes place to some depth. The knot when cut into two is found to be of hard, compact woody

tissue. Where the disease had well advanced, the branches gave the appearance of witches' brooms, bearing very few leaves and no fruits.

The fungus within the host was traced in the form of branching septate mycelium, consisting

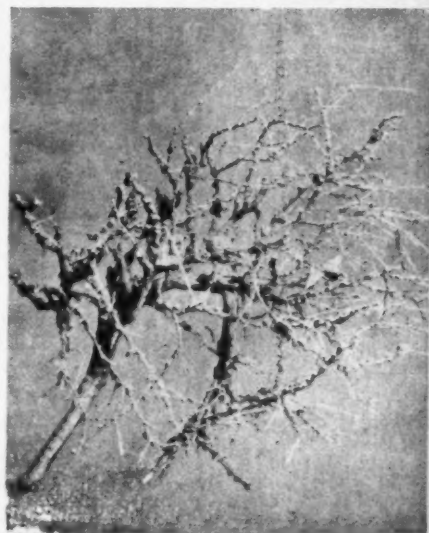


FIG. 1. Witches' broom due to *Sphaeropsis tumefaciens* on lime trees.

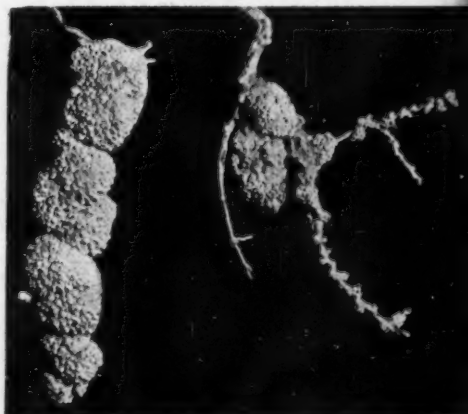


FIG. 2. Knots formed on the affected branches of lime trees due to *Sphaeropsis tumefaciens*.

of light-brown hyphae which varied from 3-5 to 5  $\mu$  in diameter. However, no fruiting bodies could be observed on the diseased branch. Large number of isolations were made from the diseased tissue on potato dextrose agar medium

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and a grey culture was obtained. After 16 days, pycnidia—pin-head—like structures—developed above the surface of the agar. They bore numerous spores and were black, papillate subglobose, erumpent, closely crowded together and  $149.5-224 \times 122-191 \mu$  in size. The spores were mostly one, but rarely, two-celled, light-brown, elliptic to fusoid, rarely botuliform, measuring  $16.5-29.5 \times 7-11.5 \mu$ . The characters of the fungus and the symptoms it causes, closely resemble with those of *Sphaeropsis tumefaciens*, reported on lime by Hedges (1911).

Authors are grateful to Shri Samarth Raj, Director of Agriculture, Rajasthan, for facilities of work.

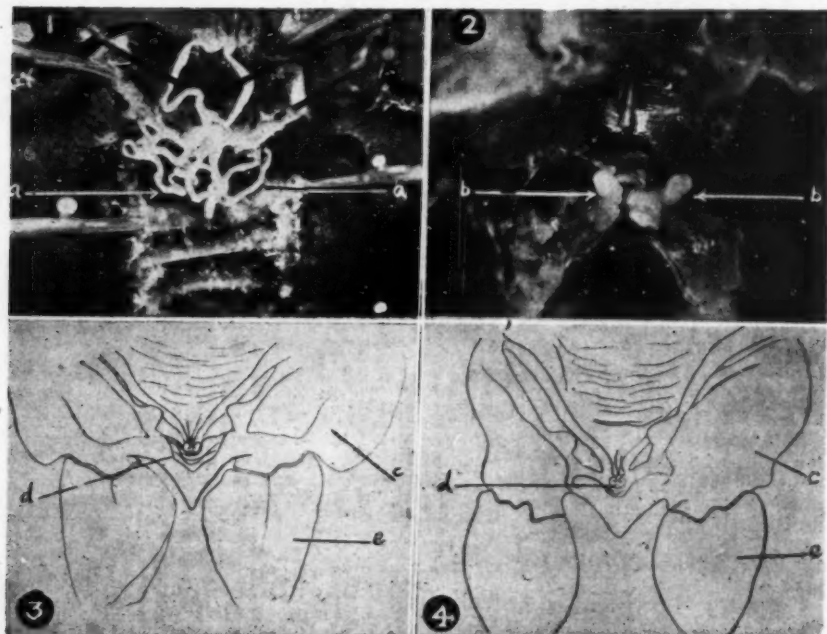
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Department of Agriculture, G. C. BHATNAGAR,  
Rajasthan, Udaipur,  
October 26, 1960.

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# **OCCURRENCE OF THORACIC GLANDS IN MYLABRIS PUSTULATA THUNBG. (COLEOPTERA : MELOIDAE)**

THERE have been numerous records of occurrence of different types of glands in various insects, but no reference to the occurrence of glands opening on the mesosternum in *Mylabris pustulata* Thunbg. or any other blister beetle could be found. In the adult male of *Mylabris pustulata* there is a pair of glands each gland being white, more or less cylindrical, tubular and about 76 mm. long with a few short branches given off from the main tubular portion (Fig. 1, a). The two glands are swollen and a little flattened just before they open into a common receptacle which in turn opens on the mesosternum. The glands are irregularly coiled and lie ventrally below the alimentary canal in the region of the first three abdominal segments and the metathorax, and proceed anteriorly between the mesosternal apophyses to open between the bases of the second coxæ on the mesosternum (Fig. 3, d). The opening is surrounded by a depressed area. If the thorax



FIGS. 1-4. Fig. 1. Adult male of *Mylabris pustulata* Thunbg. dissected to show the thoracic glands (a). Fig. 2. Adult female of the same species dissected to show the glands (b). Fig. 3. Mesosternum of male: c, mesosternum; d, opening of the glands; e, second coxa. Fig. 4. Mesosternum of female: c, d and e as in male.

of a live beetle is pressed gently, a whitish fluid is discharged through the opening of the glands, and this secretion is slightly acidic.

In the adult female a pair of similar glands as in the male is present, but they are rudimentary, being 4.5 mm. long. The tubular portion of the glands is very much reduced and the glands appear more or less retort-shaped, sac-like structures (Fig. 2, b).

Several hundreds of beetles of both sexes have been dissected, and the pronounced nature of the glands in the male and their ill-developed condition in the female were constantly observed in all cases, though there was a good range of variation in the length of the glands in the male. The function of the glands is not definitely known, though their unequal development in the two sexes suggests a function connected with sex—probably attraction of the female, but it could not be verified.

Grateful thanks are due to Dr. M. Puttarudraiah, Government Entomologist, for kind encouragement.

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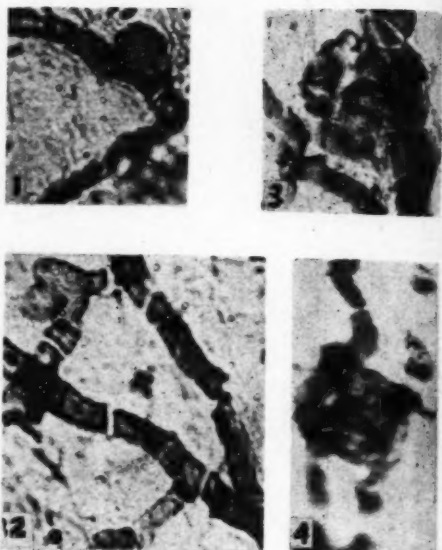
and Res. Inst.,  
Hebbal, Bangalore-6, October 15, 1960.

### ON TWO NEW GENERA OF FUNGI FROM TERTIARY COAL BEDS OF MALAYA

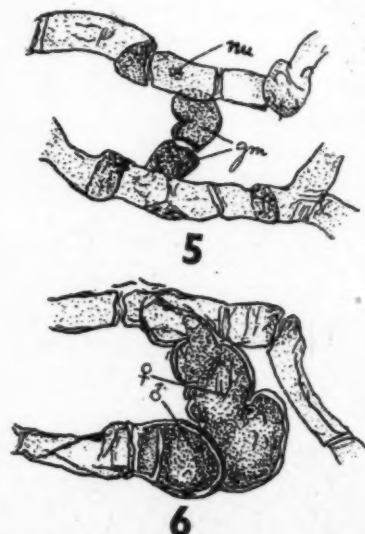
A PRELIMINARY investigation of Tertiary coal collected by one of us (B. S. T.) from Malaya in 1953 led to the interesting discovery of two fungi in fossil state, reported here.

The first shows branched septate hyphae and various stages of spore development. Figure 1 shows a spore in the initial stage, budding out from the hypha. Figure 2 shows a stalked conidiospore which has a strong resemblance with the early sporophytic stage of *Desmidiospora*, *Dematiaceae*—*Deuteromycetes*. Figure 3 shows a fully mature conidiospore with sulcate outer margin which, in spite of the absence of conidiophore, shows a close affinity with *Desmidiospora* where a long, prominent conidiophore is one of the characteristic features. The fossil fungus described here resembles *Desmidiospora* in shape, size and margin of its conidiospores. The fossil material, however, differs in having a shorter conidiophore. We regard that this fossil fungus, although not identical with *Desmidiospora*, is sufficiently nearly allied to it.

The second fungus shows profusely branched septate hyphae with various stages of sexual



FIGS. 1-4. Fig. 1. Conidiospore budding out from the septate hypha,  $\times 1,107$ . Fig. 2. Developing stalked conidiospore,  $\times 1,107$ . Fig. 3. Mature conidiospore,  $\times 1,107$ . Fig. 4. Mature zygote with a centrosphere,  $\times 1,107$ .



FIGS. 5-6. Fig. 5. Formative gametangium. gm., gametangium; nw., nucleus,  $\times 1,640$ . Fig. 6. Fusion of antheridial and oogonial walls. ♀, oogonium; ♂, antheridium,  $\times 1,640$ .

fusion. Figure 5 shows a developing curved gametangium separated from gametangiophore by a septum. It is at a stage prior to fusion between two hyphae. Figure 6 shows the fusion of the antheridial and oogonia walls. Figure 4 finally shows a zygote with a dark central area, probably the centrosphere. The stages of the fungus described above suggest an affinity with the living group Pezizaceae, order Ascomycetes. The type of sexual fusion encountered here recalls to one's mind the sexual fusion that is found in *Ascodesmis*.<sup>2-5</sup>

As far as we are aware, this is the first contribution from Malayan Tertiary beds. The two fungi reported here seem to belong to two new genera. They will be described in detail elsewhere.

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# ON THE STARCH CONTENT OF SOME SACCHARUM SPONTANEUM VARIANTS

QUALITATIVE examination of *S. spontaneum* variants for starch has indicated that some forms are very rich in starch, some contain comparatively little amounts and some are completely devoid of starch, and there appears to be a trend in starch content according to geographical distribution of the *spontaneum* variants. Starch is a very undesirable constituent in cane juice. It interferes with filtration and crystallisation of sugars. It is generally believed that more than 0.05% of it on weight of cane is harmful in the manufacture of sugar.

In the present study\* 14 *S. spontaneum* variants collected from different geographical regions were selected and analysed for starch content in the stem and leaf portions of fully mature plants. Starch was estimated in all the samples by the method of Hanes<sup>1</sup> involving the use of  $\beta$ -amylase, adopting the same procedure as reported<sup>2</sup> earlier. Of the 14 varieties studied, SES 337 A and SES 115 A were found to contain comparatively larger amounts of starch in the stem and leaf samples. In SES 337 A and 115 A, the stem samples contained 2.473% starch on residual dry weight basis and 1.033% and 1.524% in leaf samples respectively. Glagah

and SES 90 had practically no starch in the stem sample while the leaf samples of these two varieties had respectively 0.5757% and 0.4911% starch on residual dry weight basis. For the rest of the varieties, the starch content in the stem samples varied from 0.6266% in SES 106 B to 1.711% in SES 365 while in the leaf samples the variation was from 0.3387% in SES 365 to 0.9822% in SES 106 B. SES 137 A had shown 0.8806% starch both in the stem and leaf samples. Barring a few exceptions, the variants collected from places nearer to equator appear to have comparatively lower amounts. Further detailed studies are on hand on the *S. spontaneum* variants collected and assembled from all over the continent.

Grateful acknowledgments are hereby made to Dr. N. R. Bhat, Director, for affording all facilities and for his valuable suggestions; also to Shri R. R. Panje, the then Botanist, who readily supplied the material and evinced keen interest in the work.

Sugarcane Breeding K. CHIRANJIVI RAO,  
Institute, K. V. GOPALA AIYAR,  
Coimbatore-7, November 29, 1960.

\* I list of *S. spontaneum* variants studied: (1) Glagah, (2) SES 32 A, (3) SES 90, (4) SES 98 A, (5) SES 138, (6) SES 137 A, (7) SES 106 B, (8) SES 115 A, (9) SES 118 A, (10) SES 116 A, (11) SES 186, (12) SES 297 A, (13) SES 337 A, (14) SES 365.

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# INDUCEMENT OF ANTHR DEHISCENCE IN CO. 421, A "MALE STERILE" SUGARCANE VARIETY, BY POLLEN OF OTHER GENERA

THE anthers of Co. 421 do not dehisce usually. However, when its inflorescences (arrows) are bagged a few seedlings are obtained. The number of seedlings is much greater when the arrows are dusted with pollen of other genera like *Euchlaena*, *Coix*, etc. All these seedlings are considered to have been derived parthenogenetically.<sup>1</sup>

In a study of the physiological effects of the pollen on the reproductive function of Co. 421, different arrows of this variety were dusted with pollen of *Euchlaena mexicana*, *Coix lachryma-jobi*, *Narenga porphyrocoma* and *Sclerostachya fusca*, respectively and bagged. Bagged, untreated arrows and unbagged, untreated arrows of Co. 421 served as controls. Four days after completion of pollen dusting, profuse anther dehiscence was observed in

arrows dusted with pollen of the different species but relatively little in the controls. The percentage of anther dehiscence in each case is given below in Table I.

TABLE I

Treatment		Percentage of open anthers
Control:		
1. Bagged	.. ..	6.3
2. Unbagged	.. ..	10.2
Treated:		
1. Dusted with pollen of <i>Coix</i>	.. ..	67.3
2. " " <i>Euchlana</i>	.. ..	70.4
3. " " <i>Narenga</i>	.. ..	59.4
4. " " <i>Sclerostachya</i>	.. ..	39.0

In order to see the effect of the pollen extract, the pollen of *Euchlana* was extracted with absolute alcohol (10 ml. per gm.), the alcohol evaporated off and the residue taken up in 25 ml. of distilled water, sprayed on arrows of Co. 421 and they were bagged. There was 89.7% anther dehiscence in them, while in the distilled water controls, there was only 7% dehiscence. It would appear that anther dehiscence is caused by the chemical stimulus from the pollen dusted.

Sugarcane Breeding Institute, C. N. BABU.  
Coimbatore-7, November 21, 1960.

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#### PERPETUATION OF THE DOWNY MILDEW OF MAIZE (*SCLEROSPORA PHILIPPINENSIS* WESTON) ON KANS (*SACCHARUM SPONTANEUM* L.) IN INDIA

Downy mildew of maize caused by *Sclerospora philippinensis* Weston which is common in the neighbourhood of Delhi has been generally responsible for about 5% infection of the crop for the last few years. In view of the fact that the causal organism does not produce any oospores the mode of perpetuation of the disease was not clear. Recently Chona and Suryanarayana<sup>1</sup> described a downy mildew persistent on Kans (*Saccharum spontaneum* L.) a hardy perennial grass in this part of the country. They reported that the fungus was found in all parts of the plant, thus indicating systemic infection. On the basis of morphological studies, they identified it as *Sclerospora philippinensis* and suggested that it may pass under suitable conditions to maize causing

downy mildew. The appearance of downy mildew on maize crop at the Indian Agricultural Research Institute first near the infected clumps of Kans supports this view. During September 1960, the writer has been able to transmit the disease from 'Kans' to maize by inoculating the latter by sporangia collected from the diseased 'Kans' clumps. Inoculations were carried out by placing sporangial suspension in distilled water in the leaf whorl of the seedlings and also by applying it on the leaf surface. The inoculated plants were kept in a moist chamber which was placed in the open. A few uninoculated seedlings in moist chambers kept side by side served as control. All the 24 seedlings (in two-leaf stage) inoculated showed typical symptoms of downy mildew, viz., chlorosis of leaves and development of downy growth of sporangiophores on the leaf surface. Characteristic chlorotic mottle appeared on the fourth day while fully developed sporangiophores bearing sporangia were observed on the ninth day. The controls remained healthy throughout these tests. Microscopic examination showed that the germ tubes produced by the sporangia penetrated through the stomata of the inoculated leaves and gave rise to branched mycelium which spread rapidly within the intercellular spaces of the leaf. Haustoria of the fungus were observed in the host cells in several cases.

I am grateful to Dr. B. L. Chona, Mycologist, for his keen interest and help during the course of these experiments.

Division of Mycology D. SURYANARAYANA,  
and Plant Pathology,  
Indian Agricultural Research Institute,  
New Delhi, December 12, 1960.

1. Chona, B. L. and Suryanarayana, D., *Indian Phytopath.*, 1955, 8 (2), 209.

#### MANGO BUNCHY-TOP AND THE ERIOPHYID MITE

NARASIMHAN (1954) was the first to record the occurrence of *Eriophyes* sp. on mango inflorescence round about Poona, and he stated that the eriophyid mite was responsible to cause the malformation of panicles. Malformation of mango inflorescence has been noted by several workers in North India, and Sattar (1946) stated that this was doing serious damage in the Punjab. Nirvan (1953) stated that though mango malformation has already been reported by several workers he was reporting 'bunchy-top' of young mango seedlings for the first time. Tripathi (1954) gave a history of the



disease, and discussed the usage of the terms 'bunchy-top' and 'malformation'. He came to the conclusion that the former name should be applied to cases of vegetative malformation as was described by Nirvan (1953), and the latter term to the floral deformities. However, he considered that the same disease caused these two types of symptoms. Narasimhan (1959) observed that the eriophyid mite, which he recorded on mango inflorescence earlier (1954), spent its life within the tissues of axillary buds after the flowering season was over, and also suggested that the disease could be controlled by removal of affected inflorescences. In the present note the preliminary observations made and the results of certain experiments carried out by the authors are recorded.

Around Bangalore the 'bunchy-top' was observed only on young seedlings raised from mango seeds for using these seedlings for grafting purposes, and was not noticed on trees. The cluster of buds occur not only at the top of seedlings, but also in the axils of branches and leaves. Malformation of mango inflorescence, though occurring rarely here and there, is not so far such a serious malady as is reported from certain areas of North India.

With a view to see whether the eriophyid mite, usually found on the malformed twigs (bunchy-top) of mango seedlings, can cause similar malformation of twigs on healthy seedlings, mites taken from malformed twigs were introduced on to newly sprouting leaf-buds at the terminal regions of mango seedlings. For this purpose, three seedlings, which did not show any malformed twigs nor the presence of the eriophyid mite, were selected in a place well away from the gardens showing such malformed mango plants. The eriophyid mites taken from malformed twigs were carefully introduced by means of a fine camel hair brush on to just sprouting leaf-buds of the selected healthy plants. The plants were enclosed individually in cages covered with thin muslin cloth. These plants were kept under regular observation. The leaf-buds on to which mites were introduced did not result in normal leaves. New buds began to arise by the side of the original buds, and even these buds did not develop properly so that at the end of three months after the introduction of the eriophyid mite, the top of the seedlings presented a crowded cluster of buds (Fig. 1) as is usually found on malformed mango seedlings in nature.

The above experiment shows that the eriophyid mite can bring about twig malformation on

healthy mango seedlings, similar to the one seen in nature. Whether this twig malformation is the direct result of the feeding injury done



FIG. 1. Experimental mango seedling showing 'bunchy-top' induced by the eriophyid mite. Inset: top portion enlarged.

by the mite as is implied by Narasimhan (1954) or due to a virus has to be investigated. If it is due to a virus, then it is possible that the eriophyid mite may be acting as a vector.

Further work in this direction is in progress.

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Department of Agriculture,  
Bangalore (Mysore State),  
December 3, 1960.

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#### RELATIONSHIP BETWEEN STRUCTURAL AND TOPOGRAPHIC TRENDS IN KONDAPALLE AREA

WHILE conducting systematic mapping work in the Kondapalle area, the author has observed that there is some relationship between the major strike directions of the rock types and

the general trend of the hill ranges. To understand the exact relationship between them, a topographic analysis has been made at the outset, on the lines suggested by Chapman.<sup>1</sup> A small area of 6.25 sq. miles comprising the southernmost part of the hill ranges has been chosen and 148 slope measurements were made on a 4" = 1 mile topo-sheet with a contour interval of 50'. The traverse method was employed and eleven traverses were run with one inch interval in a E-W direction, nearly perpendicular to the main trend of the ridges. Along each traverse line, measurements were made for every half an inch with a slope scale which has been specially constructed. The results obtained in this quantitative slope study have been presented, following Chapman's method, in the form of a statistical slope orientation (SSO) diagram (Fig. 1).

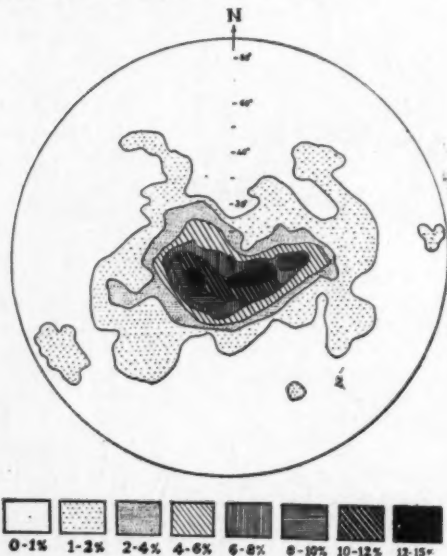


FIG. 1. SSO diagram, southern part of the Kondapalle hill ranges; slope angles are marked.

This SSO diagram clearly brings out all the major features and also makes the minor features, not clearly expressed in the topographic map, to appear more conspicuously. The symmetry of the diagram is essentially triclinic but not far from monoclinic. The diagram shows two maxima reaching a concentration of about 22% (mode). The general absence of sharp breaks in slope is indicated by the more or less continuous decrease in slope angle frequency with the increase in slope angle.

Further, 187 foliation and 94 joint directions

of the same area, together with the 148 slope strikes, are diagrammatically represented (Fig. 2) showing the relative frequencies of the same in different directions. There is a remarkable coincidence between the major slope strike

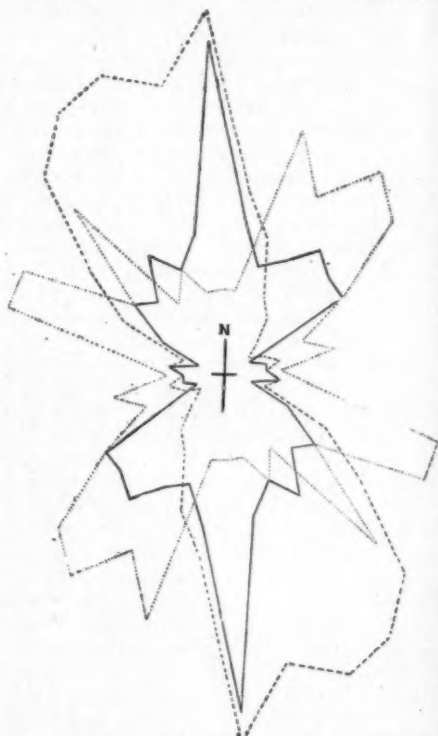


FIG. 2. Diagram showing the frequencies of the slope strikes (solid line), foliation directions (dashed line) and joint directions (dotted line).

direction and foliation direction (N 5° W). It is interesting to note that there are two sets of joints which are nearly at right angles; one of these two striking N 35° E, peculiarly enough, coincides with the minor slope strike, while the other striking N 135° E is slightly at an angle (10°) to the other minor slope. It is also noticed that where the foliation frequency is generally less, the joints are at maximum. It can, hence, be surmised that the major trend of the hills is dominantly controlled by the foliation directions, while the minor slopes are influenced by the joint pattern.

My thanks are due to Dr. S. Balakrishna for his help and guidance.

Geology Dept., CH. LEELANANDAM,  
Osmania University,  
Hyderabad-7, December 9, 1960.

1. Chapman, C. A., *Am. J. Sci.*, 1952, 250, 428.

## REVIEWS

**An Introduction to Homological Algebra.** By D. G. Northcott. (Cambridge University Press), 1960. Pp. xi + 282. Price 42 sh. 6 d.

Professor Northcott, author of a remarkable Cambridge tract on Ideal Theory, is now to be thanked for a no less remarkable Introduction to *Homological Algebra*.

From the time of its creation by H. Poincaré until recently, the discipline called first Combinatorial Topology, then Algebraic Topology, grew as a mixed structure in the sense of Bourbaki, its purpose being to derive topological invariants from the analysis of certain algebraic structures. These had to be linked up in a certain manner to manifolds, or to subsets of topological spaces and, to realize such an association, various, mostly disconnected, methods were available. For a long time the need of a more unified treatment was keenly felt but it is only during the last twenty years or so that great progress was made to achieve it. As a consequence the conviction gradually gained ground that Algebraic Topology was more than a mere combination of two well-known structures; that it was pregnant with an altogether new branch of Algebra. In 1956, H. Cartan and S. Eilenberg published their celebrated *Homological Algebra*, a first treatise on this new branch and an astonishing feat because, dealing with a newly born theory, it was setting it forth in a state of remarkable maturity.

Now, although carefully and clearly written, this treatise was assuming on the part of the reader a good deal of familiarity with Modern Algebra and, to a certain extent, with Algebraic Topology. That is why the book under review should be most welcome by students about to start on research for it does not take for granted more than an elementary knowledge of groups and rings. In fact the first two chapters are concerned only with fundamentals of General Algebra, in particular with tensor products, (O)- and exact sequences. Homological Algebra proper begins only with Chapter 3 which is about categories and functors. The important notions of Homology Functor and of Connected Homomorphisms are dealt with in Chapter 4. The author does not derive them, as it is usually done, from the theory of modules with differential operators. Following Yoneda he prefers to start with the

notions of diagrams over a ring and of functors on translation categories; the case of a particular diagram yields the homology functor. In spite of its theoretical interest such an approach may fail to satisfy inexperienced algebraists. The chapter ends with a brief mention of homotopy. One may regret that such an important notion, and also that of homotopy operator, should receive so little attention. Chapter 5 treats of complexes and resolutions, particularly of projective and injective resolutions, of modules and of sequences of modules. Now the ground having been fully prepared Chapter 6 introduces the central notions of Homological Algebra: functors of complexes and derived functors. Chapter 7 makes a detailed study of torsion and extension functors, the most important derived functors.

It was likely that the author's intention was not to burden the student with too many new notions. This would explain why no mention is made of spectral sequences. Fortunately those who wish to acquire a good grasp of them may now consult the *Théorie des Faisceaux* by R. Godement (Hermann, Paris) published almost at the same time as the book under review.

Chapter 8 is about various refinements and the last two chapters are devoted to two noteworthy applications: the theory of homology and of cohomology of groups or monoids and the theory of homological dimension, as well as of global dimension of noetherian rings. Chapter 9 gives an excellent account of the research work carried out recently, mostly after 1956, regarding the latter.

This is a lucid and scholarly Introduction to Homological Algebra and it cannot but be too warmly recommended. Its admirable get-up does great credit to the Cambridge University Press.

C. RACINE.

**Foundations of Modern Analysis.** By J. Dieudonné. (Institute des Hautes Etudes Scientifiques, Paris. Published by Academic Press, New York and London), 1960. Pp. vii + 361. Price 68 sh.

The book under review is the tenth contribution to the Pure and Applied Mathematics series of Monographs and Text-books edited

by Paul A. Smith and Samuel Eilenberg on behalf of the Academic Press. The book is an outgrowth of course of lectures on Modern Analysis delivered by the author at the Northwestern University during 1956-57. The main purpose of writing this book is best explained in the following words of the author about the motive of the course of lectures at the Northwestern University: "The purpose of the course was two-fold: to provide necessary elementary background for all branches of modern mathematics involving analysis and to train the students in the use of this most fundamental mathematical tool of our time—the axiomatic method".

The book is divided into eleven chapters with the headings Elements of the Theory of Sets; Real Numbers, Metric Spaces; Additional Properties of the Real line; Normal Spaces; Hilbert Spaces; Spaces of Continuous Functions; Differential Calculus; Analytic Functions and Application of Analytic Functions of Plane Topology; Existence Theorems; and Elementary Spectral Theory.

The author throughout lays emphasis on the "conceptional" aspect of the notions rather than the "Computational" aspect. Although the book includes considerable material generally treated in courses on "Advanced Calculus", the point of view with which this material is presented is entirely different, as the fundamental concepts of function theory and of calculus have been introduced within the framework of a theory which is sufficiently general to reveal the scope, the power and the true nature of these concepts. At no stage does the author resort to "geometric intuition" in the formal proofs of the theorem. The book is self-contained and a reader needs only the knowledge of the first rules of mathematical logic, mathematical induction, and fundamental properties of the set of integers and of the elements of linear algebra in addition to a good working knowledge of classical analysis as a prerequisite for the study of the book. In order to achieve economy in space the author introduces from the very outset the accepted notations of modern mathematics. Besides, a reader, who has worked through this introductory course on Modern Analysis, will not find himself lost in the maze of the notations when he takes to the study of books on higher mathematics.

The treatment of the various topics is lucid, clear and rigorous. The book contains a large number of well-chosen problems. The problems may be regarded in most cases as supplementary to the basic text so that it is binding on any

serious student of the subject to work out all these problems. This will not only enrich his knowledge of the subject but will also give him confidence in his grasp of the fundamentals.

The book is a valuable addition to the list of books on modern analysis. In the opinion of the reviewer, the book will be found very suitable as a text-book for the courses on Modern Analysis in the Indian Universities.

P. L. BHATNAGAR.

#### Industrial Electric Furnaces and Appliances.

By V. Paschkis and John Persson. (Interscience Publishers, New York, London), 1960. Second Edition. Pp. 607. Price \$24.00.

The revised and enlarged second edition of *Industrial Electric Furnaces and Appliances* by V. Paschkis and John Persson is the consolidated presentation of the earlier two-volumed first edition which came out without the collaboration of the second author named in this edition. Study and design of electric furnaces in general covering as it does thermal and electrical problems apart from the chemical and metallurgical aspects needs a two-pointed view and this has been well met by the two authors who are experts in their respective fields.

The book is divided conveniently into 5 chapters.

The first chapter which is designated as the general part covers the first principles of heat transfer—an aspect often neglected by both the designer and the operators of furnaces—electrical laws, and the economic considerations from the industrial standpoint.

The second chapter deals with arc furnaces, specifically the open arc furnaces, submerged arc furnaces and some special types, like skull melting furnaces, cold mould furnaces, etc. In all these cases, there is evidence of a systematic presentation starting with basic principles, thermal and electrical considerations, general descriptions, furnaces parts and operation. Oxygen lancing and indirect stirring which is becoming increasingly important have also been rightly touched upon. Also the empirical data derived from a wide variety of metallurgical processes have been correlated with dimensional analysis, giving a new approach to the whole problem.

Resistance furnaces and appliances are discussed next under a separate chapter, giving details of indirect heat furnaces of the conduction, convection and the radiation types; direct heat furnaces and the resistance appliances and their role, significance and application.



In chapter IV is discussed the induction and dielectric heating giving details of general aspects, power supply, types of furnaces and appliances, design and economic considerations. The calculation aspects have been excellently dealt with and this would greatly help in understanding the basic thermal and electric principles.

Lastly, the fifth chapter deals with the selection of furnaces, touching upon the methods of selection, energy losses, heating and melting processes.

By and large the book deals only with thermal and electrical problems with an accent on calculations programmed for digital computers and the direct analog computers, and is of significance to the electrical furnace builders and operators and no less to those of fuel-fired ones. The text contains some 151 graphs, 233 diagrams, 43 tables and 51 illustrations.

The book has been very well got up and is recommended not only to the builders and designers of electrical furnaces but also to the metallurgical engineer.

A. A. K.

#### Representations of Primes by Quadratic Forms.

Prepared by Hansraj Gupta, M. S. Cheema, A. Mehta and O. P. Gupta. Edited by J. C. P. Miller. (Published by the Royal Society at the University Press, Cambridge), 1960. Pp. xxiv + 135. Price 45 sh. net.

The tables give, for primes  $p$  not exceeding 100,000 the representation of either  $p$  or  $2p$  in the forms  $a^2 + 5b^2$ ,  $a^2 + 6b^2$ ,  $a^2 + 10b^2$ ,  $a^2 + 13b^2$  whenever any such representation exists. The tables also give, in such circumstances, the least value of  $n$  such that  $n^2 + 5$ ,  $6$ ,  $10$  or  $13$  is divisible by  $p$  or  $2p$ , the quotient  $k$  being given also.

These results provide useful numerical evidence concerning the erratic and interesting way in which these quantities vary and may contribute to the understanding of such unsolved questions as 'Is the number of primes of the form  $n^2 + 5$  or  $n^2 + 6$ , etc., infinite or finite?'

The tables contain an introduction which outlines the theory of quadratic fields and of the factorization of ideals in such fields. V.

**The Living Body**, 4th Edition. By C. H. Best and N. B. Taylor. (Chapman & Hall Ltd., London, W.C. 2), 1959. Pp. 756. Price 45 sh.

Human physiology is always a fascinating subject having universal interest. It is one of

those everwidening fields of study where the more we know the more there is yet to know.

The rapid advances that have been made during the last decade in the various disciplines of Biology, Biochemistry and Medicine have so changed our conceptions regarding the defensive mechanism of the human body against diseases, the process of immunity, the metabolic activity of the body and the theory of nutrition that any book written on the subject soon becomes out of date. One should also be wary in accepting new findings till they have been well established and passed from the field of controversy. These facts have been taken into account in preparing the Fourth Edition of the book *The Living Body—A Text in Physiology*.

This edition has also been given a new look in size and get-up which readers will find more convenient to handle than the previous edition. A number of new figures have been added and many of the old ones have been redrawn and improved. A comprehensive pronouncing glossary of over twenty pages has been appended to the text.

A. S. G.

**Radar Meteorology**. By Louis J. Battan. (University of Chicago Press, Cambridge University Press, London N.W. 1), 1959. Pp. xi + 161. Price 45 sh.

Since World War II and especially during the last decade radar meteorology has developed phenomenally. This development has taken place mostly in U.S.A., thanks to a relatively small group of organizations which had all the facilities for productive research in this field. The literature on the subject, however, is scattered in journals and out-of-print conference reports. Hence the present publication by one who can write with authority on the subject, setting forth for the first time in book form a summarized account of the important advances that have been made in radar meteorology during the last fifteen years, will be welcomed by practising meteorologists and students of meteorological science.

The 150-page book contains 15 chapters. The first chapter gives a brief account of the principles of radar and the three chief types of indicators or display scopes used in weather radar, namely, the simple A-scope used to identify the source of the back-scattered energy, the PPI (plan-position indicator) scope specially useful for observations of severe storms, and the RHI (range-height indicator) scope particularly useful in cloud studies. Then



there are chapters on properties, propagation, and attenuation of electromagnetic waves. These are followed by chapters on micrometeorology, namely, radar detection of spherical and non-spherical particles and precipitation measurements. Use of radar in cloud physics research has been somewhat extensively dealt with. A chapter has been devoted to radar in mesometeorology, a term used to designate medium-scale meteorological phenomena having space and time scales between the microscale and the large scale. In this comes the study of thunderstorms, squall lines and tornadoes. This is followed by a chapter on radar study of larger-scale weather systems and precipitation patterns associated with hurricanes and cyclones. Finally there is a chapter on special instrumental techniques.

The book which is profusely illustrated will be an indispensable guide book for all those working on radar meteorology.

A. S. G.

**The Plasma Proteins, Vol. II. Biosynthesis, Metabolism and Alterations in Disease.** Edited by F. W. Putnam. (Academic Press, New York and London), 1960. Pp. xv + 518.

The book gives an excellent account by various authorities on topics relating to biosynthesis, metabolism and alterations in disease of the plasma proteins. The opening chapter contains an account of the structure and functions of human serum lipoproteins by F. T. Lindgren and A. V. Nichols. A valuable contribution by W. H. Fishman brings together results of extensive studies on plasma enzymes. H. A. Antoniades has given a critical account of hormones found in plasma in the normal state. The subject of blood coagulating system present in plasma has been ably dealt with by R. G. Macfarlane. The comparative biochemistry and embryology of plasma proteins found in different animals have been critically reviewed by R. L. Engle and K. R. Woods. The subject of biosynthesis of plasma proteins has been exhaustively dealt with by H. S. Anker. The fascinating subject of alterations in plasma proteins in disease has been critically reviewed by M. L. Petermann. F. W. Putnam has given an account of the subject of abnormal serum globulins. The important subject of genetic alterations in plasma proteins of man has been dealt with by D. Gitlin and C. A. Janeway.

In the preface to the book, the editor F. W. Putnam has stated that the purpose of the treatise is to present an authoritative, inter-

pretive and integrative account of the subject. The reviewer feels that the above objectives have been amply achieved by the different contributors and the editor. The book will continue to serve for a long time to come as a volume of reference to biochemists and clinicians interested in the subject. The editor and the contributors are to be complimented in bringing out this volume of outstanding value in a field in which rapid advances have been made during recent years.

M. SWAMINATHAN.

**Advances in Organic Chemistry: Methods and Results (Vol. 2).** Edited by Ralph, A. Raphael, Edward C. Taylor and Hans Wynberg. (Interscience Publishers, New York), 1960. Pp. vii + 504. Price \$ 15.00

The useful publications under "Advances in Organic Chemistry" have been continued and Volume 2 has appeared with the following contents: Alkenylmagnesium Halides, Dialkoxydihydrofurans and Diacyloxydihydrofurans as Synthetic Intermediates, Ethynyl Ethers and Thioethers as Synthetic Intermediates, Ketene in Organic Synthesis, Nuclear Magnetic Resonance in Organic Structural Elucidation, Hydrogenation-Dehydrogenation Reactions, Ultra-violet Photochemistry of simple unsaturated systems, The Chemistry of muscarine. As a man working in the field, I have already been benefited by the appearance of this Volume. Particularly welcome is the inclusion of "The Chemistry of Muscarine", and I would look forward to the inclusion of the following topics in future volumes: Gibberellic Acid, Recent Developments in the Application of Borohydrides and Diborane, Zone Refining Technique.

D. K. BANERJEE.

**Darwin's Place in History.** By C. D. Darlington. (Oxford, Basil Blackwell; Macmillan & Co., Ltd., London, W.C. 2), 1959. Pp. iv + 101. Price 9 sh. 6 d.

The centenary of the publication of the "Origin of Species" by Charles Darwin was celebrated recently. At such a time there is usually an attempt to gloss over the failings and to highlight the achievements. The passage of a century should enable a critical appraisal of Darwin's place in history without being troubled by the feeling that a great figure should not be dissected. The book under review, therefore, is unusual in that it attempts such analysis.

The biologists of the 19th century were rather chary about "quoting the more important ante-

cedent authorities". Darwin was no exception. The reader of the *Origin* is given the impression that the whole problem of evolution came to the fore only with the voyage of the Beagle and that Darwin's theory was something new. The passing reference to the views of his grandfather, Erasmus Darwin, gives the impression that he merely "anticipated the erroneous grounds of opinion and the views of Lamarck" (p. 33). This does not appear to be an accurate evaluation. Erasmus Darwin while conceding that heredity may be soft and may be capable of alteration by the environment also suggested that changes can occur as a result of competition and selection and envisaged even "sexual selection", an idea elaborated later by his grandson.

The belief that heredity may be soft, that the environment may direct the variation even before it arises and that inheritance of the effects of use and disuse may be responsible for evolution was nothing new. But when Lamarck combined these ideas into a working hypothesis, biologists suddenly became aware of the opposition between the roles of direction and selection in evolution and the possibility or otherwise of experimental verification.

The first to record their disagreement were three medical men, Wells, Lawrence and Prichard. Lawrence, a Professor at the Royal College of Surgeons, emphasized in his book, *Natural History of Man* (1819), that "neither climate nor food nor civilization nor government had any influence on the differentiation of races" (p. 18). This scientific approach to the problem ignoring, as it did, persons and proprieties became anathema to the church and state. Since persecution and ruin faced him, he wisely suppressed his book and prospered in life!

"Darwin's unawareness of what his contemporaries were thinking matched his unawareness of what his predecessors had written" (p. 27). The views of Darwin and Wallace do not also appear to be identical. Wallace repudiated the views of Lamarck. Darwin, while emphasizing the role of natural selection, conceded the possibility of the inheritance of acquired characters. "He leaves open a line of retreat from *caused to directed*, the line he was later with unnoticed steps to follow" (p. 26).

Samuel Butler tried to destroy, what he called, the *myth of Darwinism* by indicating how the ideas of Darwin were nothing new. Yet another source unacknowledged by Darwin has recently been brought to light. Edward Blyth analysed in three articles (1835-37) a

variety of problems relating to evolution with a view to substantiate his belief in the stability of species.

Jenkin, a Professor of Engineering in London, marshalled arguments against evolution in general and natural selection in particular. He emphasized that variations may be of different types, that they may be abrupt and discontinuous and that they may breed true without blending quite contrary to what was envisaged by Darwin. Deferring to Jenkin's arguments, Darwin gradually retreated from natural selection in successive editions of the *Origin* and presented the view that the environment may cause as well as direct the change. His theory of pangenesis was intended to bolster up the Lamarckian mode of inheritance. Darwin's theory of evolution became thus very difficult to "distinguish from anybody else's theory of evolution" (p. 40).

Some of the discoveries of Mendel were anticipated by Charles Naudin in a paper which appeared a year earlier (1864) than that of Mendel (1865). Hooker invited Darwin's attention to the above publication. Unable as Darwin was, to appreciate the impact of the earlier discoveries on cellular basis of reproduction or the difference between one and two grain pollinations or between the first and second generation hybrids, the particulate theory of heredity was not appreciated by Darwin. Inheritance of acquired characters is inconceivable if one accepts Mendelian interpretation of heredity.

This 100-page essay on Darwin's place in history is a challenging booklet and provides stimulating reading. But how far the reader will agree with the different issues raised is a moot point.

M. K. SUBRAMANIAM.

Report of the Rothamsted Experimental Station for 1959. (Harpendon, Herts, England). Pp. vii + 103. Price 10 sh.

Rothamsted Experimental Station needs no introduction to Agricultural Research workers. The Report of the Station for 1959 gives as usual the summary of work done in the various departments now over twelve in number. The report reveals a number of problems, influencing the range and aim of research and the attention bestowed to meet the needs of the farmer. In addition to distinctly useful subjects as fertiliser use and plant protection, the report deals with a number of subjects of ultimate importance, such as international language for computers, identity of biological active materials, potential

plant nutrients and virus distribution in infested plants.

A remarkable instance, how a warning to spray the beet-root crop against Aphids increased the yield by 25% on an average, and in some cases, even 100% is reported. It is mentioned that the spraying technique was initiated only in 1957. The short general report of the Director of the Institute at the beginning of the volume, on "the range and aim of research" is a valuable summary of the position of Agricultural Research and would prove extremely useful to those who are still sceptical about the practical values of Agricultural research. Another good feature of the report is a valuable abstract of scientific papers given at the end.

The report contains information of fundamental value and it is certain a perusal of this report from the oldest and the most famous agricultural research centre will be of great interest to workers all over the world. [K. R.

**Medicinal Chemistry.** (2nd Edition). Edited by Alfred Burger. (Interscience Publishers, New York), 1960. Pp. xiii + 1243. Price \$ 37.50.

'Medicinal chemistry' is a branch of science rather difficult to define and to delimit. A medicinal chemist must be experienced in organic chemistry, physical chemistry, biochemistry, pharmacology, microbiology and many phases of medicinal therapeutics. Besides isolation, characterization, elucidation of the structure and the synthesis of compounds likely to be helpful in alleviating suffering, medicinal chemistry is also concerned with the understanding of the chemical and biological mechanisms involved in its action and in establishing relationship between chemical structure and biological activity.

Rapid development in all these fields during the last decade has necessitated the publication of the second edition of this comprehensive treatise. The extremely difficult task of synthesizing and presenting the vast material from such varied disciplines in a lucid manner has been ably handled. Assistance of more than thirty contributors has been utilised in presenting the specialized topics discussed in this volume.

The volume is not merely a compendium on drugs; the scope of the text envisages structural analysis and synthesis of important medicinal chemicals; briefly presents the methods of biological testing; and discusses biochemical mechanisms of drug action.

The book is addressed principally to the more advanced readers. The contribution by a large number of scientists, specialists in their own domain, has given the volume a status of an authoritative treatise, to be considered as a standard work of reference in medicinal chemistry.

M. SIRSI.

#### Books Received

**Advances in Analytical Chemistry and Instrumentation** (Vol. I). Edited by Charles N. Reilly. (Interscience Publishers, New York), 1960. Pp. vii + 445. Price \$ 12.00.

**Mechanism in Radiobiology**, Vol. II: **Multi-cellular Organisms**. Edited by M. Errera and A. Forssberg. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. xiii + 395. Price \$ 13.00.

**Advances in Geophysics**, Vol. 6: **International Symposium on Atmospheric Diffusion and Air Pollution**. Edited by F. N. Frenkiel and P. A. Sheppard. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1959. Pp. xvii + 471. Price \$ 12.00.

**Toxic Phosphorus Esters—Chemistry, Metabolism and Biological Effects**. By Richard D. O'Brien. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. xii + 434. Price \$ 14.50.

**Organic Chemistry**. By C. W. Wood and H. K. Holliday [Butterworth & Co. (Pub.) Ltd., London W.C. 2], 1960. Pp. xxii + 321. Price 21 sh.

**Cytology and Evolution**. By E. N. Willmer. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. x + 430. Price \$ 10.00.

**Biological Activities of Steroids in Relation to Cancer**. Edited by G. Pincus and E. P. Vollmer. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. xvi + 530. Price \$ 15.00.

**Symposium on Comparative Biology**, Vol. I: **Comparative Biochemistry of Photoreactive Systems**. By M. B. Allen. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. xii + 437. Price \$ 12.00.

**Classical Electricity and Magnetism**. By E. S. Shire. (Cambridge University Press, London N.W. 1), 1960. Pp. xvi + 396. Price 45 sh.

**Inorganic Chemistry**. By C. W. Wood and A. K. Holliday [Butterworth & Co. (Pub.) Ltd., London W.C. 2], 1960. Pp. viii + 393. Price 21 sh.

## SCIENCE NOTES AND NEWS

### Award of Research Degree

Andhra University has awarded the D.Sc. Degree in Physics to Miss P. R. K. L. Padmini for her thesis entitled "Ultrasonic studies in liquid states".

Karnatak University, Dharwar, has awarded the Ph.D. Degree in Physics to Messrs. V. M. Korwar and M. I. Savadatti for their theses entitled "Electronic Transition moment variation in aluminium oxide band system" and "Spectroscopic study of methyl alcohol flames" respectively.

### Indian Society of Genetics and Plant Breeding

At the Twenty-first Annual Meeting of the Society held at Roorkee on January 3, 1961 the following Office-bearers were elected:

**President**—Dr. E. K. Janaki Ammal; **Vice-Presidents**—Dr. A. R. Gopal Ayengar, Dr. A. B. Joshi; **Secretary**—Dr. M. S. Swaminathan; **Councillors**—Dr. S. M. Sikka, Dr. S. Govindaswamy, Prof. P. N. Bhaduri, Dr. B. S. Kadam, Shri G. P. Argikar, Dr. K. Ramiah; **Editor**—Dr. B. P. Pal.

### Rafi Ahmed Kidwai Memorial Prize

The First Rafi Ahmed Kidwai Memorial Prize for significant research in the field of Agricultural Botany was awarded in September 1960, to Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi, for his outstanding contributions in the field of wheat breeding and genetics and for evolving the famous Pusa wheat varieties. This is one of the eleven prizes instituted by the Indian Council of Agricultural Research in 1958, to commemorate the memory of the late Shri Rafi Ahmed Kidwai, Union Minister of Food and Agriculture.

### International Congress of Radiation Research

The Second International Congress of Radiation Research will be held at Harrogate, Yorkshire, England, August 5th to 11th, 1962. It is sponsored by a Committee set up at the First Congress at Burlington, Vermont, in 1958, and by the Association for Radiation Research. The programme will be concerned with the physical, chemical, biological and medical effects of radiations, particularly ionizing radiations. Research workers in these fields will be invited to proffer

original papers and reports of new experimental work. A brochure will be available in April 1961. Information may be obtained from Dr. Alma Howard, Secretary-General, the Second International Congress of Radiation Research, Mount Vernon Hospital, Northwood, Middlesex, England.

### Sixth Congress on Theoretical and Applied Mechanics

The Indian Society of Theoretical and Applied Mechanics held their Sixth Congress in Delhi, on December 24-26, 1960. It was preceded by a one-day symposium on High Speed Computation Methods and Machines arranged by the Society jointly with the International Business Machines Corporation.

The half-hour addresses were delivered by R. Sauer (W. Germany), J. Kampe de Fariet (France), H. Zorski (Poland), H. B. Squire (England), H. Langhaar (U.S.A.) and G. N. Meshcheryakov (USSR). R. Sauer spoke on three-dimensional problems in gas dynamics and showed the application of characteristic grid methods to unsteady planar and steady spatial gas dynamic problems. J. Kampe de Fariet described the statistical mechanics of linearized plane sound waves in a perfect gas filling the whole space. H. Zorski gave a review of Polish papers and some new results on plates with discontinuous boundary conditions. H. B. Squire spoke on the theory of radial jet flows and described experimental work concerned with such flows. H. Langhaar gave an account of the general theory of stability of conservation system. G. N. Meshcheryakov spoke on the nature of self-excited vibration in metal-cutting processes.

In each of the two technical sessions on Fluid dynamics, and Elasticity and allied topics some twenty papers were presented and discussed. The next Congress will be held at the Indian Institute of Technology, Bombay, in December 1961.

### I.C.A.R. Grant to *Current Science* for the Year 1959-60

The Current Science Association acknowledge with thanks the grant of subsidy of Rs. 3,000 for the year 1959-60 from the Indian Council of Agricultural Research, towards printing of *Current Science*.



**Central Building Research Institute, Roorkee**

The 48-page Annual Report of the Central Building Research Institute, Roorkee, for the year 1959-60 shows a record of increased activity both on the research side and on the practical side of the dissemination of the results of research not only to government departments but also to manufacturers of building materials, contractors and others who are primarily concerned with them. The Building Materials Division's investigations during the year on clay and cementitious products, mortars and renderings, paints and polishes are mentioned in brief. The Soil Engineering Division reports the tests carried out on the safe allowable pressure on sandy soils. This section undertook during the year subsoil explorations and testing at the site of seven public buildings to be built in Delhi.

The division which goes under the name of Efficiency of Building has reported its activities on acoustical, thermal and illumination studies of buildings, ventilation and climatology studies, connected with building designs.

The latter half of the report contains matters dealing with administration, publications and equipment.

**Fertilisers and Rice Production in India**

In an article on "what fertilisers could do to increase world food production" Dr. H. L. Richardson of the Imperial Chemical Industries Ltd., discusses the field experiment results of the fertiliser programmes carried out in some of the agriculturally less-developed countries like China, India, Ghana and Mexico. The crops selected for study are the chief cereal crops in each country. About the possibilities of increasing rice production in India Dr. Richardson has the following to say:

Bringing together the information from various publications, I found an average response of rice to fertilisers in India of 590 lb. of rough or paddy rice per acre. This is the combined effect of nitrogenous and phosphatic fertilisers, applied where needed, at 30 lb. each of nitrogen and phosphate per acre. Figures for the average unfertilised yield in the trials are not available, but the overall average yield of paddy rice in India—most of which is unfertilised—in 1,140 lb./acre. On this basis the direct response to fertilisers is 52%.

The effects of other methods of agricultural improvements and their interactions with fertilisers could be reasonably estimated as 20% increase due to improved crop varieties, another

20% for cultural methods, and 10% for pest and disease control, the total being 50%. Adding this to the direct response to fertilisers, the combined effect of fertilisers and other developments proceeding simultaneously would be about 102%. In other words, present rice yields would be doubled. The average improved yield of rice in India would then become 2,300 lb. of rough or paddy rice per acre, which appears to be a realistic figure. It lies, for example, between the present average rice yields in Malaya (2,000 lb./acre) and in Formosa (2,700 lb./acre).

By modern standards the rates of application used in the Indian fertiliser trials were low ones: this was because (a) Indian farmers are unaccustomed to handling chemicals, and (b) the varieties of rice now grown in India cannot make use of much nitrogen. As the farmers gain experience and better rice varieties are produced, heavier rates of fertiliser use will become practical. From fertiliser response curves I estimate that 80 lb. of nitrogen per acre, used on improved varieties along with phosphate and potash at  $\frac{1}{2}$  cwt. per acre, where needed, would produce an average direct response of 1,040 lb. of paddy rice per acre in India, or 91% of the present average yield. Adding to this another 50% for other agricultural improvements would give an overall increase in yields of 140%, with an average production of 2,700 lb. of paddy rice per acre.

With further improvement and intensification of farming, that is likely to occur in India under the stress of hunger, we may well expect that average yields of 3,000 lb. per acre will eventually be achieved if not in this generation then in the next. There is certainly no climatic barrier as such to obtaining high rice yields in India. In officially observed competitions, Indian rice farmers have already produced yields on individual fields of from 8,400 to 11,200 lb. of paddy rice per acre.—(*Advancement of Science*, 1961, 17, 474).

**Long-Distance Signals Via Moon**

Pye and Co. engineers working in conjunction with scientists of the Radio-astronomy divisions at Jodrell Bank and Sydney successfully transmitted on February 24, 1961, the first long-distance message via the moon from Britain to Australia. The message consisted of telegraph and teletypewriter signals. At Jodrell Bank, the giant radiotelescope was used for outward transmission, and the signals were received in Sydney by a new radiotelescope installed by



the CSIR organization. It will be recalled that on May 14, 1959, signals were transmitted to America from Jodrell Bank via the moon.

#### Raman Spectrum of Gaseous $CF_4$

There have been only two investigations so far of the Raman Spectrum of tetrafluoromethane in the gaseous state. The first was the early investigation by Yost et al., in 1936, and the second a more recent one by Claassen in 1954. Monoston and Weber have reported the results of their preliminary investigations on the Raman Spectrum of  $CF_4$  under high dispersion using a 21-ft. concave grating and employing the excitation technique developed by Stoicheff. They obtain well-resolved vibration-rotation bands. The fundamental vibrations occur at  $908.5\text{ cm}^{-1}$  ( $a_1^*$ ),  $435.0\text{ cm}^{-1}$  ( $e$ ),  $1283.0\text{ cm}^{-1}$  ( $f_2$ ) and  $631.2\text{ cm}^{-1}$  ( $f_2$ ). The resolution of the bands in the present method is found to be very favourable for the direct evaluation of the coriolis coupling coefficients.—(*J. Chem. Phys.*, 1960, 33, 1867).

#### A Zone Plate Spectrometer for the Far Infra-Red

A spectrometer based on a Fresnel zone plate as the focusing and dispersing element has been constructed for use with infra-red radiation between  $35\text{ }\mu$  and  $80\text{ }\mu$ .

The instrument is intrinsically simple. A heated nichrome coil and a Fresnel zone plate are mounted on opposite ends of a 4-m. I-beam so that the zone plate produces a series of monochromatic images of the source disposed along the axis of the instrument. A bolometer detector mounted on a carriage moves along a straight track attached to the I-beam so as to scan the spectrum.

The zone plate is of the reflecting type, containing 234 half-wave Fresnel zones. The surfaces of the even-numbered zones are raised  $12.5\text{ }\mu$  above those of the odd-numbered zones to give a maximum optical efficiency at  $50\text{ }\mu$ . The zone radii are calculated to make the system free from spherical aberration at  $68\text{ }\mu$  and to give the zone plate a focal length of  $73.5\text{ cm}$ . at that wavelength.

The zone plate focuses a monochromatic image of the source directly on the bolometer element with no intervening collimating mirrors, or movable slits, as in a grating spectrometer. The simplicity of this design leads to ease of construction and good lightgathering power.—(*Nature*, 1961, 189, 212.)

#### Whistlers

Whistlers are electromagnetic radiations of natural origin found in the audio-frequency band of the radio spectrum where they normally appear as quasi-musical tones of descending pitch. Their source is in the earth's outer ionosphere, the exosphere, which is now shown to extend to much greater height than was believed a decade ago. Whistlers have provided considerable information on the exospheric electron density, but an understanding of their origin requires a knowledge of the positive ions and their distribution in the exosphere. One view is that solar protons, injected into the earth's magnetic field, provide the bulk of the positive ions. Another view considers the exosphere to be populated by hydrogen which has diffused from the lower ionosphere and ionized by charge exchange or some other process, and has been trapped in the earth's magnetic field. These conflicting ideas only emphasize the need of measurements of the positive-ion constituents of the exosphere.

In a paper contributed to the *Canad. J. Phys.*, 1960, 38, 1642, Barrington and Nishizaki have reported results of analyses, by a specially developed filtering technique, of four low-altitude whistlers observed in Japan. Employing a model exosphere in which it is assumed that above some transitional level the positive ions are mostly hydrogen, an estimate of  $1,000\text{ km}$  for the height of the transitional level is obtained.

#### New Theory of Universe—Explosive Evolution Rather than 'Steady State'

An intriguing question in Astronomy has been "was the universe created in an instant or has it always looked much the same as it does today?"

Professor Martin Ryle, Professor of Radio-Astronomy at Cambridge, in a paper presented to the Royal Astronomical Society on February 10, 1961, has put forth a new theory of the universe based on his intensive study of distant radio-emitting galaxies. The new theory leads to the conclusion that the universe has "evolved" from an initial explosion of highly compressed matter.

The evolutionary theory grew out of Einstein's general theory of relativity and was given impetus in the 1920's, when it was observed that all the galaxies were receding from the earth as in the pattern of an "explosion". In 1948, however, Bondi, Gold, and Hoyle proposed an

alternative picture which avoided the necessity for a single moment of "creation" and which did not involve any large-scale changes in the universe. According to this view, the universe was everlasting, and, in order to explain the recession of galaxies, they suggested that new matter was being continually created everywhere throughout space and that this matter condensed to form new galaxies to replace those lost to view as the expansion continued.

The possibilities of distinguishing between these two pictures has been a major theme in the programme of the great optical telescope. In the "steady state" model, the density of the galaxies would have been just the same in the past as it is now. In the evolving, or "explosion", model, on the other hand, the density is getting progressively less.

We cannot observe nearby galaxies for long enough to detect any change in their density but, since light from the most distant galaxies has taken some thousands of millions of years to reach the earth, observers, in effect, see them as they were that time ago. Thus we can compare distant and nearby regions of space and look for differences both in density and constitution. On the explosion model, distant galaxies will appear to an observer younger than nearby ones, while on the steady-state model each

volume of space will contain a mixture of young and old galaxies.

The new science of radio-astronomy has made it possible to probe deeper and deeper into space—possibly to distances of 8,000 million light-years, or four-fifths of the observable limits of the universe, because at distance of about 10,000 million light-years the speed of recession of the galaxies exceeds that of light, and neither light nor radiowaves from them can reach the earth.

Investigations, therefore, have been carried much further than was hitherto possible by optical means, and the conclusion reached by Professor Ryle and his associates is that the steady-state model cannot represent the actual universe. It is observed that radio-emitting galaxies are more densely distributed in the most distant parts of the universe than at lesser distances.

Steady-state protagonists are by no means convinced, however, and Professor Fred Hoyle, Professor of Astronomy at Cambridge, has said that much more work would be necessary, and that before he could accept the evolutionary theory it would have to be shown that no new galaxies were forming.—(British Information Service.)

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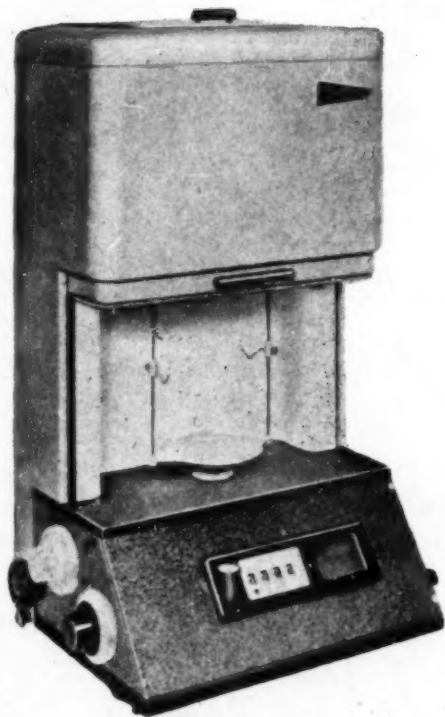
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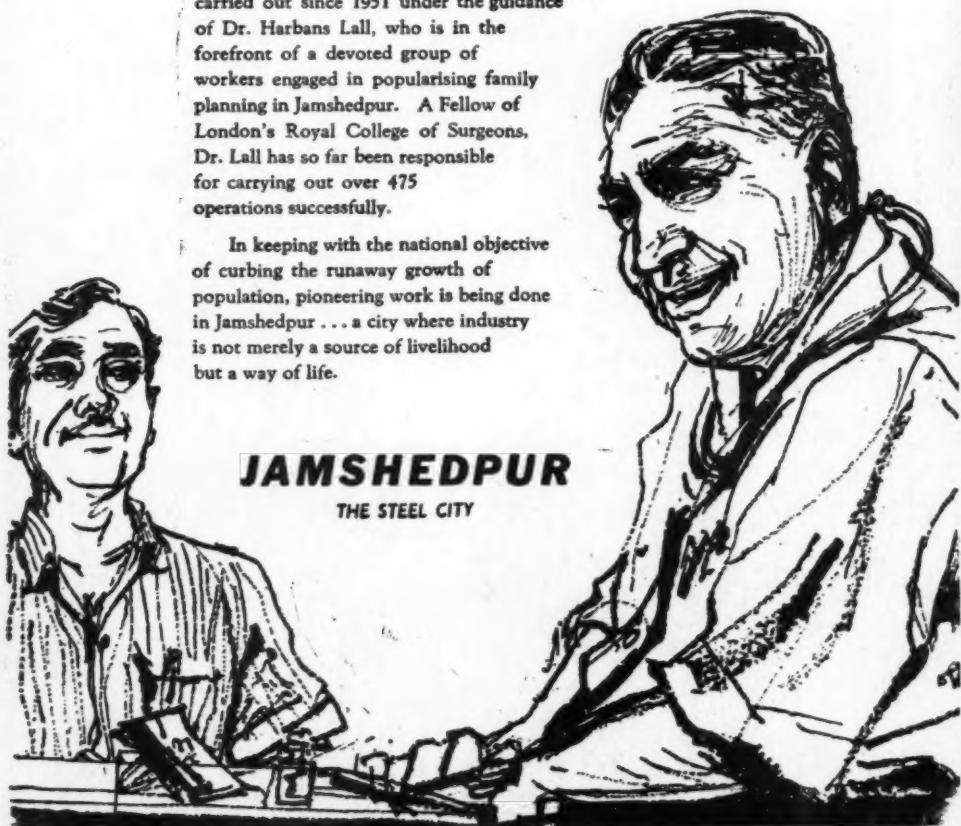
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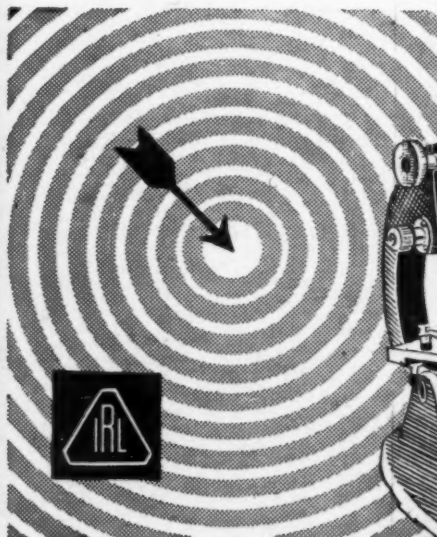
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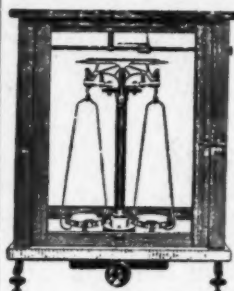
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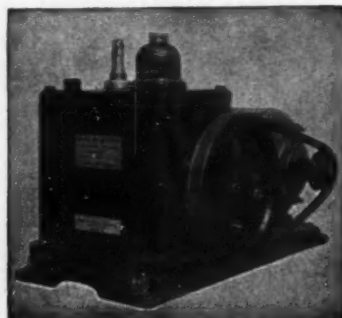
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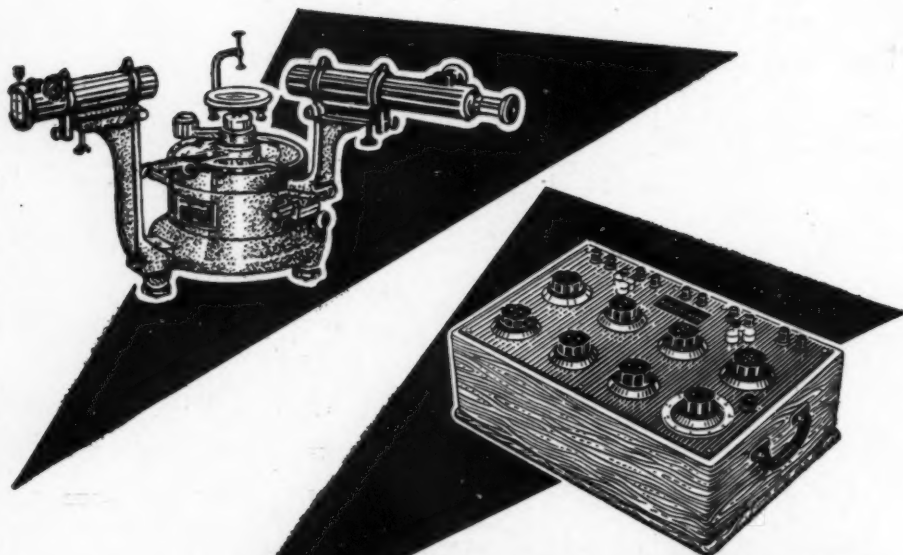
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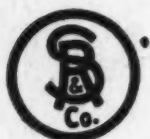
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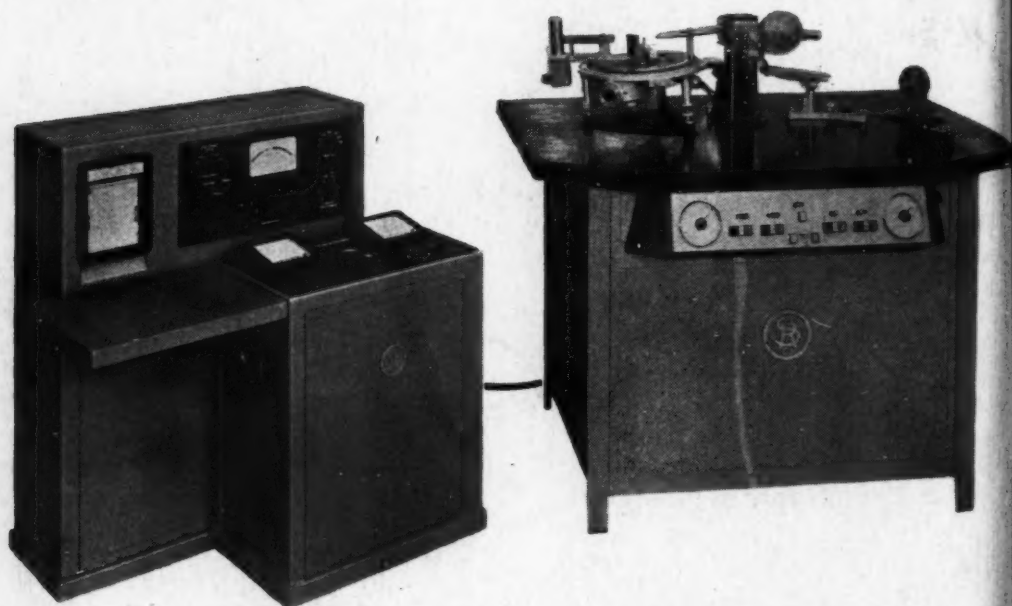
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